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On the geology and natural history of the upper Missouri

F. V. Hayden

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TRANSACTIONS

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AMERICAN PHILOSOPHICAL SOCIETY.

ARTICLE I.

ON THE GEOLOGY AND NATURAL HISTORY OF THE UPPER MISSOURI.*

BY F. V. HAYDEN, M.D.

Read July 19th, 1861.

HISTORICAL INTRODUCTION.

In presenting a report upon the geological structure of the vast country drained by the Missouri river and its tributaries, it is but just to those who have preceded me that I should give a brief statement of the results of different travellers who have passed over that region, premising, however, that no detailed account has hitherto been given of its geological character.

The first reliable account of the Upper Missouri country was obtained by those enterprising travellers, Captains Lewis and Clarke, and published in their excellent journal;†

* Being the substance of a report made to Lieut. G. K. Warren, T. E., U. S. A., by F. V. Hayden, M.D., Surgeon and Geologist of the Expedition to the Upper Missouri and Yellowstone, under the command of Lieut. Warren.

† Lewis and Clarke's Journal of an Expedition to the Sources of the Missouri River, performed during the Years 1804, '5 and '6.

and though they appear to have had no definite idea of the geological age of the region examined by them, they gave so accurate descriptions of the general physical features of the bluffs, coal-beds, &c., that their report has proved an excellent guide to subsequent explorers. They often mention beds of "stone coal" (lignite), different strata of sands, sandstones, clays, &c., yet do not suggest any idea of the age of these deposits. A small collection of cretaceous fossils obtained by these travellers enabled Dr. Morton* to identify the existence of the Cretaceous formation in that country.

In 1832, the Prince of Neuwied made an expedition up the Missouri river, and the results of his travels were embodied in a magnificently illustrated work. The sketches taken from nature present a very vivid and accurate idea of the country. He mentions the occurrence, in numerous localities, of sands, clays, and lignites, and also observes that he collected Ammonites, Baculites, and other Cretaceous fossils, all along the river from the sources of the Missouri to Big Sioux. This statement led Von Buch to observe that "this great river (Missouri) flows uninterruptedly from the foot of the Rocky Mountains through strata of Chalk, at least as far as the mouth of Sioux river. This is the result of the accounts and collections of Prince Neuwied and of the report of the celebrated astronomer Nicollet."† Nothing very definite was ascertained however respecting the geology of the country by this expedition, except to confirm the fact of the existence of a Cretaceous formation on the Upper Missouri, indications of which had already been determined from the collections of Lewis and Clarke. He also obtained a fine specimen of the remains of a saurian animal, characterizing the Cretaceous Period, which has been described by Goldfuss as Mosasaurus Maximiliani, fragments of which were in the collections of Lewis and Clarke.

The next important expedition into that country was made in 1839, by the distinguished geographer Nicollet. He ascended the Missouri no farther than Fort Pierre in lat. 44° 23′, yet from his observations the first reliable information was obtained respecting the extent and interest of the Cretaceous rocks in that region.

He secured a considerable number of Cretaceous fossils at different points along the Missouri, but especially at the Great Bend; all of which were described by Conrad and Morton in the Proceedings of the Philadelphia Academy. Although passing rapidly through the country he formed a tolerably accurate idea of its geology, and gave in his report a vertical section of the Cretaceous rocks, which is correct, excepting that he seems to have had no knowledge of No. 2, and represented two of the subdivisions of No. 3 as dis-

* Synopsis of the Organic Remains of the Cretaceous Groups of the United States, &c., by S. G. Morton. Philadelphia, 1834.

† Silliman's Journal. September, 1850.

tinct formations. No. 1, he seems to have referred to the Carboniferous system. As he did not go above Fort Pierre he saw nothing of No. 5, though he obtained some of its characteristic fossils, which may have been presented to him by members of the American Fur Company.

Mr. Edward Harris, who accompanied Mr. Audubon to the mouth of the Yellowstone in 1843, was instructed by the Academy of Natural Sciences at Philadelphia to make some observations on the geology of that unknown region. This communication to the Academy on his return was very interesting, and contained many important facts, and from his notes and collections the committee were able to arrive at still more important conclusions. The committee, consisting of Professors Rogers, Morton, and Johnson, reported that they found incontestable proofs of a freshwater formation in that region. From one locality Mr. Harris obtained a specimen of "brown ferruginous rock, containing three or four species of freshwater univalve shells of the genera *Limnea*, *Planorbis*, &c. One of the species of *Planorbis* it is conjectured may be a form extinct, but the mutilated condition of the specimen prohibits a positive opinion. This bed of clay also contains leaves of deciduous trees, bearing a close resemblance to those of the Beech."

At various times, specimens of Mammalian remains were brought in by gentlemen connected with the American Fur Company, indicating the existence of an interesting deposit on White river; the first account of which was published by Dr. H. A. Prout of St. Louis, in the American Journal of Science, 1847.

In 1849, Dr. John Evans, one of the assistants in the geological survey of the Chippeway Land District, under the direction of Dr. D. D. Owen, was sent by that gentleman on an expedition to the Mauvaises Terres of White river. He there secured a fine collection of Mammalian and Chelonian remains, which were investigated by Professor Leidy of Philadelphia. He also collected many interesting Cretaceous fossils, which were described by Dr. Owen, and published in his final report in 1852. Dr. Evans's observations embracing a section of the Bad Lands, together with a description of their physical features, were also published in this report.

In the following year Mr. Thaddeus A. Culbertson visited the Upper Missouri country under the auspices of the Smithsonian Institution, during which expedition he collected some interesting vertebrate remains from the White river formations. He also ascended the Missouri on the Fur Company's boat, to a point above Fort Union, noting the character of the surface of the country, and the occurrence of lignite beds at various localities.

In the spring of 1853, Dr. Evans again visited this country incidentally, while on his way to Oregon Territory, in the geological survey of which he was engaged, under the patronage of the General Government. During this expedition he made another extensive collection of vertebrate remains and some freshwater Mollusca at the Bad Lands of White

river, as well as some Cretaceous fossils from Sage creek. The Mammalian remains of this expedition were also studied by Dr. Leidy, and the invertebrate fossils by Drs. Evans and Shumard, and published in the Proceedings of the Academy of Natural Sciences at Philadelphia, and the Academy of Sciences of St. Louis.

At the same time (1853), Mr. F. B. Meek and the writer, were employed by Professor James Hall of Albany, New York, to visit the Bad Lands of White river, for the purpose of making a collection of the Tertiary and Cretaceous fossils of that region. Many interesting and important facts were obtained during the expedition, in regard to the geological structure of the country from Fort Pierre to Council Bluffs, which formed the basis of a paper read by Professor Hall before the Association for the Advancement of Science at the Providence meeting, in the summer of 1855. The Mammalian remains collected during this trip were placed in the hands of Dr. Leidy for examination, and the new species of Cretaceous fossils were investigated by Messrs. Hall and Meek, in an interesting memoir published in the Transactions of the American Academy of Arts and Sciences at Boston. A brief vertical section accompanied this memoir, showing the order of the superposition of the different Cretaceous beds.

Subsequent to all these expeditions the writer again visited Nebraska and spent two years traversing various portions of that country; part of which time he was aided by Col. A. J. Vaughan, Indian Agent, and afterwards by Mr. Alexander Culbertson and other gentlemen of the American Fur Company. During this expedition he explored the Missouri to the vicinity of Fort Benton, and the Yellowstone to the mouth of Big Horn river, also considerable portions of the Bad Lands of White river and other districts not immediately bordering on the Missouri. The vertebrate remains collected by him, as may be seen by reference to the various papers by Prof. Leidy in the Proceedings of the Academy, embrace a larger number of species than all those previously known from that country, many of which belong to new and remarkable genera.

Large collections of mollusca were also obtained from Cretaceous and Tertiary formations, which have since been published by Mr. Meek and the writer, with remarks on the geology of different portions of the country, in several memoirs read before the Academy of Natural Sciences at Philadelphia. The geological results of the different expeditions along the Missouri and other portions of the Northwest, under the command of Lieutenant Warren, are embodied in the following report.

In regard to the geology and natural history of Kansas and the southern portions of Nebraska, or the Platte country, important facts were secured by those enterprising explorers, Cols. Long, Fremont, and Emory, and Capt. Stansbury. These have been already published in their several reports.

PART I.

DESCRIPTIVE GEOLOGY OF THE ROUTES.

CHAPTER I.

EXPLORATION OF PLATTE RIVER VALLEY FROM BELLEVUE TO THE MOUTH OF ELKHORN RIVER.

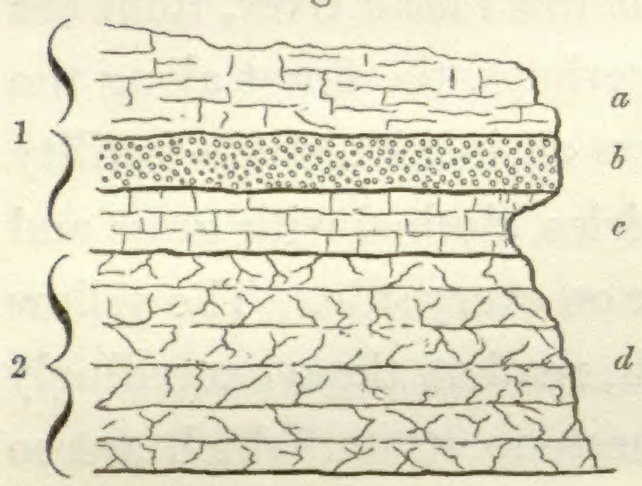
Landed at Bellevue, Nebraska, five miles above the mouth of the Platte river, from the steamer Twilight, June, 1857. The scenery at this point is, perhaps, the finest along the Missouri. The river bottoms, which are quite extensive, possess an inexhaustible fertility and sustain a luxuriant vegetation, while the broad upland prairies, clothed with grass and flowers of great variety and beauty, meet the eye of the traveller on every side. The yellow silicious marl, which underlies the high prairies to a great depth, renders them exceedingly well adapted to agricultural and grazing purposes. The limestone strata, which are so much valued here for economical purposes, belong to the age of the Upper Coal Measures, and constitute the basis formation of this region. A fine quarry may be seen near Col. P. A. Sarpy's old Trading Post, which has been diligently wrought for several years. The following section in descending order will represent the different beds as exposed in this vicinity:

1. Light gray limestone, well charged with fossils, *Fusulina cylindrica, Productus, Chonetes,* and several species of corals. This limestone is quite useful for building purposes and forms excellent lime.
2. Yellowish drab argillaceous limestone, very hard and compact; useful in the construction of buildings, but contains too much clay for lime. Fossils: *Allorisma terminalis,* &c. 6 to 10 feet.
3. Argillaceous shaly limestone, of a grayish brown color. Fossils: *Spirigera subtileta, Fusulina cylindrica, Productus* several species, *Chonetes, Allorisma,* and quite abundant crinoidal remains. Seen at Bellevue at low water. 6 feet exposed.
4. Compact blue argillaceous limestone having much the character of hydraulic limestone; soft and moist in place but hardening on exposure; contains too much clay for lime, but is quite useful for building purposes. Fossils: same as above mentioned. Seen at the mouth of the Platte, and at St. Mary's, Iowa. 6 feet exposed.

Trip from Bellevue to mouth of Elkhorn River.—While delaying for a time at Bellevue, in June, 1857, I took that opportunity to make a somewhat minute examination of the Platte valley as far as the mouth of Elkhorn river, a distance of about thirty miles. Having secured a horse through the kindness of Stephen Decatur, Esq., I left Bellevue pursuing a southerly course across the beautiful undulating prairies bordering on the

Missouri to the Papillion creek. Saw at this locality, on Mr. Watson's claim, a fine quarry of gray and yellowish gray limestone, same as bed 4 of the section. On the Platte river, six miles above its mouth, observed numerous large granite boulders scattered over the surface of the high hills. A bed of sandstone (No. 1, Lower Cretaceous) makes its appearance at this point, capping the bluffs. Its general character is a dark, ferruginous, coarse-grained, micaceous sandstone, but sometimes becoming a very tough compact silicious rock. Near the old Otoe village, eight miles above the mouth of the Platte, is a very good exposure exhibiting the sandstone resting conformably upon the Carboniferous Limestone. We have here the following beds in descending order:

Fig. 1.



1. Gray, compact, silicious rock, passing down into a coarse conglomerate, an aggregation of waterworn pebbles, cemented with angular grains of quartz; then a coarse-grained micaceous sandstone. 25 feet.
2. Yellow and light-gray limestone of the coal measures containing numerous fossils, *Spirifer cameratus*, *Spirigera subtileta*, *Fusulina cylindrica*, *Productus*, *Chonetes*, and abundant corals and crinoidal remains.

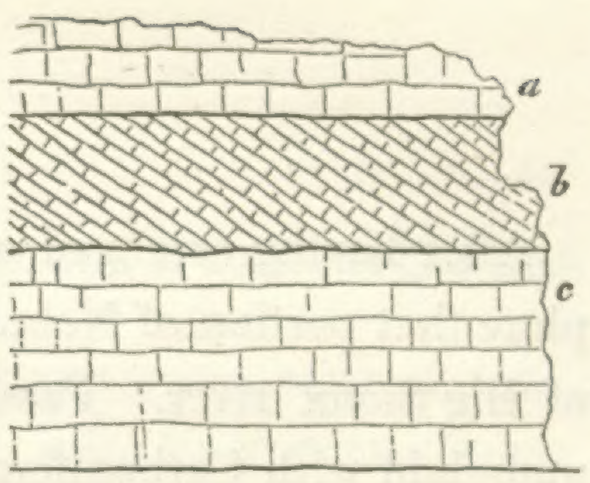
a, quartz rock; *b*, conglomerate; *c*, coarse friable sandstone; *d*, carboniferous limestone.

A seam of carbonaceous shale, twelve to eighteen inches in thickness, crops out occasionally near the water's edge, and is regarded by the inhabitants as a sure indication of coal. The great scarcity of timber throughout this region would render such a discovery of the highest importance; but I am inclined to the opinion that it is a geological impossibility for a workable seam of coal to be found within the limits of the Territory of Nebraska. The limestones of Southeastern Nebraska belong to the Upper Coal Measures, and form the extreme northwestern rim of the great coal basin, and, inasmuch as the strata dip toward the northwest in ascending the river at least one foot to the mile, there must be from 600 to 1000 feet of clays, shales, and limestones, over the first seam of coal two feet in thickness, in any part of the country near the mouth of the Platte. A bed of coal to be really valuable for economical purposes, should be at least three feet in thickness, and even then it would not prove profitable if a large amount of labor were required in opening the mine.

Near the mouth of the Elkhorn, the sandstone presents much the same character as before described. At this point it reaches nearly to the water's edge, showing that the dip of the formations in this region is toward the northwest. Here formation No. 1 is at least eighty feet in thickness, about fifteen feet of Carboniferous limestone being exposed beneath. The latter soon passes beneath the water-level of the river, and the sandstone occupies the country.

Although all the rocks in this region are composed of strata holding a horizontal position, or dipping at a very small angle, examples not unfrequently occur in sandstone formation No. 1 of what is usually called "false or cross stratification," as is shown in Fig. 2, which was taken from the bluff exposed at the mouth of Elkhorn river, and indicates the different changes that took place in the currents of water that deposited the arenaceous sediments. Strata *a* and *c* are formed of thin horizontal layers of sandstone, while the lamina of stratum *b* seemed to have been deposited upon an inclined surface in very shallow water. Similar illustrations were observed by the writer in the Potsdam sandstone of the Black Hills, and they occur frequently in arenaceous rocks of all countries.

Fig. 2.



The bottoms along the Lower Platte are quite broad and extremely fertile, possessing a rich soil, and admirably adapted to the wants of the farmer. Fine crystal springs issue from the limestone banks, a sufficiency of timber skirts the river or clothes the bluffs, the climate is quite dry and healthy, and if it were not for the extreme cold of winter this region would be one of the most desirable agricultural districts in the West. The timber of the uplands consists chiefly of ash, elm, oak, soft maple, boxwood, &c.; while along the bottoms the cottonwood forms nine-tenths of the woodland. The land when in a state of nature supports a most luxuriant vegetation, and when cultivated by the farmer brings forth very abundant crops. The valley of the Elkhorn is similar to that of the Platte, and the land is at this time mostly taken up by the actual settler. The bluffs are formed of sandstone No. 1, often presenting lofty vertical walls, which, from the yielding nature of the rock, are of great service to the Indian, upon which to record his hieroglyphical history.

On my return to Bellevue, I passed over the upland prairie, several miles north of the Platte. Already nearly every valuable claim was occupied by the persevering pioneer, and as far as the eye could reach, the plain was dotted over with farmhouses, giving it much the appearance of an old-settled country. Very little timber, however, is to be seen except that which skirts the small tributaries of the Platte. The soil upon the surface is composed of a rich vegetable mould, the result of the annual decay of a luxuriant vegetation, underlaid by a yellow silicious marl, and is admirably adapted for the cultivation of all kinds of cereal grains and for grazing purposes. When the prairie turf is broken up by the plough and allowed to decay, the land becomes like a garden. The soil is so loose that it is tilled with great ease, but from this very fact is liable to suffer extensively from the wash of the heavy drenching rains of May and June.

CHAPTER II.

FROM BELLEVUE TO THE BIG SIOUX RIVER.

After having arranged my collections for transportation to St. Louis, I proceeded to explore that portion of Nebraska which borders on the Missouri from Bellevue to the mouth of Big Sioux river. Passing over an undulating country similar to that just described, underlaid with Carboniferous limestone, we find that Fort Lisa is the highest point on the river where these rocks are exposed. At Tekama, the ferruginous sandstone alone is seen presenting its usual lithological characters and containing much iron. This entire formation abounds with iron ore of the red hematite variety, which, if the deficiency of fuel in the country can be supplied from any other source, might be made of great economical importance. From this sandstone issue some excellent springs of water. The most important one is Golden Spring at Central Bluffs, which yields a large supply of pure cold water, and will at some future period become a great resort for seekers after health and pleasure.

From De Soto to Decatur, a distance of forty miles, the river bottom, on the Nebraska side of the Missouri, averages about five miles in width, forming a level prairie, with here and there a small grove of cottonwood. On the Iowa side, from Council Bluffs to Sergeant's Bluffs, a distance of one hundred miles, the bottom averages about ten miles in width, covered in many places with heavy bodies of timber, chiefly cottonwood, with a mingling to some extent of ash, elm, black walnut, &c. These broad bottoms possess an inexhaustible fertility, as is shown by the annual growth of vegetation, which year by year decaying adds still more to the richness of the soil. The subsoil seems to be composed of calcareous and silicious marls, formed from eroded materials of the Cretaceous and Tertiary rocks, which have been washed down by the river and mingled together upon its bottoms.

Above Fort Lisa the first cut banks we observed which afford a good section of the beds are at Wood's Bluffs, near Decatur.

Section of the strata in descending series:

1. Yellow Silicious marl, a recent deposit. 15 feet.
2. Yellow indurated clay, with a reddish tinge, also recent. 6 to 8 feet.
3. Heavy-bedded sandstone. 40 to 50 feet.
4. Yellow indurated clay passing down into an indurated ash-colored clay with a reddish tinge. 5 feet.
5. Ash-colored clay with a small seam of lignite at base. 25 feet.

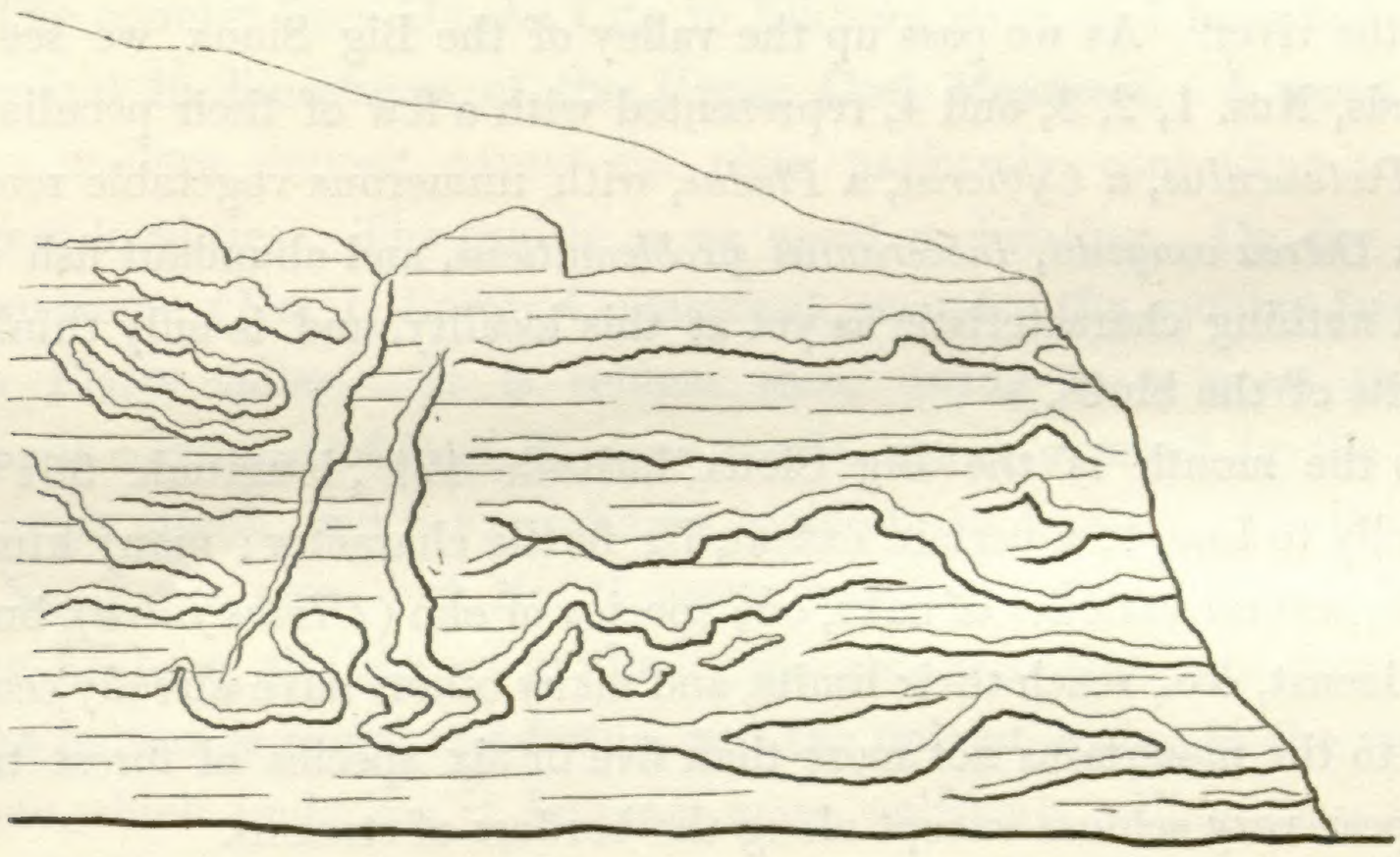
No fossils were observed at this locality excepting quite uncharacteristic vegetable remains. But near the Blackbird Mission, eight miles above, the sandstone is quite rich

in impressions of dicotyledonous leaves. The following section of the beds in descending order is exposed at this point:

1. Yellow marl, recent. 10 to 15 feet.
2. Yellowish and light gray, fine indurated grit, recent. 10 to 15 feet.
3. A reddish friable sandstone, passing down into a very tough compact silicious rock of a greenish gray color. The whole bed fully charged with vegetable impressions, quite well preserved. 10 to 20 feet.
4. Forty feet slope. The rocks though not exposed at this point are evidently formed of more friable sandstone, as is shown by the perpendicular bluffs cut by the river, three miles above, also at Wood's Bluffs, near Decatur.

The more compact silicious rock has been quarried during the winter and spring, and used in constructing a fine three-story building for the Omaha Mission, and it was found to serve an excellent purpose. The whole bed at this locality seems to be filled with impressions of leaves, mostly of dicotyledonous trees, some of them closely allied to our recent oaks, willows, &c., with many forms not represented among living species. Fragments of silicified wood abound with globular masses of the sulphuret of iron.

Fig. 3.



The bluffs of sandstone near this locality often present the appearance shown by Fig. 3. The whole surface being covered with projecting seams of iron, the more yielding arenaceous material being eroded, giving to the face of the bluff a very rugged aspect.

After stopping at Blackbird Hill three days enjoying the hospitality of Dr. Sturgis, the gentlemanly superintendent of the Mission, I pursued my course along the banks of the river toward the Big Sioux, about forty miles distant. The red sandstone No. 1 is the principal rock in that region, but upon the sandstone I often found layers of rather

soft yellowish white limestone fully charged with *Inoceramus problematicus* and fish remains. Near the north side of the Omaha reserve another bottom commences, averaging about five miles in width—greatest width ten miles—extending up the Missouri, above the village of St. John's. Dacota City is located on this broad level bottom.

At Sioux City, on the Iowa side, is a fine quarry in formation No. 1, which has yielded much excellent building-stone, and many attempts have been made to convert it into lime. The simple application of an acid would have shown it to be nearly destitute of calcareous matter. The whole bed presents the variation in color and structure peculiar to this rock. The more compact stratum extends below the water level, and will at some future day form a superior landing for steamboats. A few fossils have been found at this locality, impressions of leaves like the common willow, and some molluscous remains. Scattered over the high hills are exposures or outliers of formation No. 3, the rock of which is extremely calcareous, and is eagerly sought after by the inhabitants and converted into lime. I saw a load of this lime sold at Sioux City for the enormous price of one dollar and twenty-five cents per bushel. In the valley of the Big Sioux river, about three miles above its mouth, a bed of lignite is exposed, eighteen inches to two feet in thickness, but very impure. This is the same stratum seen near the Omaha Mission, at Omadi and other points along the river. As we pass up the valley of the Big Sioux, we see the different Cretaceous beds, Nos. 1, 2, 3, and 4, represented with a few of their peculiar fossils. No. 1 contains a *Pectunculus*, a *Cytherea*, a *Pholas*, with numerous vegetable remains; Nos. 2 and 3 contain *Ostrea congesta*, *Inoceramus problematicus*, and abundant fish remains; No. 4 has yielded nothing characteristic as yet at this locality, and is only thinly represented on the summits of the bluffs.

As we pass the mouth of the Big Sioux, latitude 42½°, longitude 96½°, the country begins gradually to lose, to a certain extent, its fertile character; many kinds of trees, as the soft maple, several varieties of oaks, one species of elm (*Ulmus fulva*), butternut, black walnut, wild locust, &c., reach their limits, and many others have already ceased to appear. From thence to the mountains not more than five or six species of forest trees are seen, and these appear very seldom except along the borders of streams.

Returning again to join the expedition at Omaha City, I found the travelling very difficult and was much delayed. A severe storm of rain had swollen all the small streams to an enormous extent, so that the bridges were all swept away. The yielding nature of the alluvial banks of streams, and the want of firm rock foundations, render it difficult to erect permanent bridges which will resist the strong power of the current of the rivers when swollen to their greatest height, as they frequently are in the months of May and June.

After an examination of that portion of Nebraska already occupied by settlers, I came to the following conclusions:

1. That the portion of Nebraska east of longitude 98° possesses a very fertile soil, a sufficiency of timber for all immediate purposes, is well watered, and is surpassed by few portions of the West as an agricultural and grazing country.

2. That, except in the southeastern or limestone region, there are very few good quarries of stone for building or other economical purposes.

3. That from its geological structure, the existence of workable beds of coal in the southeastern portion of Nebraska is quite problematical.

4. That, with the exception of iron in moderate quantities, no minerals will be found that can be rendered valuable for economical uses.

CHAPTER III.

FROM OMAHA CITY TO FORT LARAMIE.

July 3d. The country from Omaha City to Elkhorn river, as I have before mentioned, is mostly underlaid by limestones of the Upper Coal Measures. A great thickness of yellow marl, a modern deposit, covers the plain uniformly, concealing the limestones, except in a few localities. The prairie is as usual undulating. On the Elkhorn, the ferruginous sandstone (No. 1, Lower Cretaceous), occupies the country for about eighty miles up the Platte valley. It is seldom seen, owing to a great thickness of a superficial deposit composed of Post Pliocene marls. It is exposed in the valley of the Loup fork, near its mouth, and is exceedingly friable in its texture. On the distant hills remnants of No. 3 are seen, but No. 2 seems wanting. As we follow up the Platte valley from the Elkhorn, the timber gradually disappears in the same manner as on the Missouri. The bottom is broad and fertile, and the upland, owing to the yielding nature of the sandstone which underlies it, becomes more uniformly rolling than the limestone region near the Missouri.

July 20th. Indications of No. 3 were seen in the bed of Beaver creek, near the water's edge.

July 21st. Near the old Pawnee village, I observed No. 3 close to the water's edge, presenting its usual lithological characters, with a few specimens of *Inoceramus problematicus;* and overlying it stray masses of a pebbly conglomerate cemented with a calcareous grit, undoubtedly belonging to the upper beds of the Tertiary formation. After leaving Beaver creek I observed a change in the external features of the hills, more

abruptly undulating, as well as in their lithological characters, and am now convinced that they belong to the upper members of the Tertiary, probably Post Pliocene, but yet holding a lower position than the yellow marls of the Missouri.

July 22d. About two miles above our camp Loup fork cuts through undoubted Tertiary beds. The following section will show the strata in descending order:

1. Yellowish brown laminated grit; effervescing with muriatic acid.
2. Similar to the bed above but of a deeper color and containing a greater per cent. of clay with numerous calcareous concretions disseminated through it. 75 to 100 feet.
3. Light brown clay, with many whitish particles like magnesia. 20 feet.
4. Gray coarse grit, forming a heavy-bedded sandstone reaching to the water's edge. 30 feet.

In bed 2d I found fragments of the bones of mammals and turtles, and the whole series may be referred to the Pliocene period.

At the mouth of Calamus river the strata are represented as follows:

1. Yellowish brown grit. 12 feet.
2. Limestone assuming a concretionary form. 2 to 2½ feet.
3. Calcareous clay quite indurated. 6 feet exposed above the water's edge.

Lieutenant Warren explored the Calamus fork for about 30 miles above its mouth and saw the same beds represented in the above section, sometimes with an aggregate thickness of fifty feet, and gathered from them numerous water-worn fragments of bones and shells of turtles.

July 25th. Soon after leaving camp, a bed of arenaceous limestone was observed in several localities apparently containing traces of organic remains. There were many silicified tubes ramifying through the rock, which may have been the stems of plants, also many seeds like cherry-stones. Sometimes the rock becomes a partial conglomerate. The incoherent material above and below the more compact bed, is a yellow marl.

July 27th. Tertiary beds were observed throughout the day and a few bones and teeth were collected.

July 28th. Passed over a country very similar to that of yesterday, but the high hills are becoming apparently more rugged. They are cut through by numerous streams, forming ravines one hundred to two hundred feet in depth. The sandhills are also appearing.

July 29th. Passed through the sandhills all day. They have now become quite conspicuous, rising to the height of fifty to one hundred feet.

August 1st. Measured the height of the sandhills from the bed of the Loup fork with a pocket level, and found that the highest point was about two hundred and twenty feet above the water level of the river. I think, however, that there is not so great a

thickness of loose material, but that Pliocene beds form the base. The middle portion is Post Pliocene, and on the top from fifty to one hundred feet of loose incoherent sand.

August 2d. There are very few exposures of the different beds in the valley of the main branch of Loup fork, but fifteen miles south of our road towards the Platte, a branch of the Loup fork seems to pass between nearly vertical banks. One of them exhibits a section which shows the Pliocene character of the beds:

1. Yellowish-brown grit.
2. Whitish chalky stratum containing many freshwater shells. 3 feet.
3. Heavy-bedded gray grit. 8 to 10 feet.

From this point to the head of Loup fork the geology of the country is similar, consisting of sandhills and recent Tertiary beds. The true Tertiary beds are concealed for the most part by superficial deposits, a few places only being exposed by denudation. From these I was able to collect some interesting vertebrate remains, as a new species of *Mastodon* (*M. mirificus*), *Hipparion*, *Cervus*, *Elephas*, &c. The whole of this portion of the country may be regarded as a desert, nearly destitute of wood and water. From the head of Loup fork we pursued a northwest course to the Niobrara river. The surface of the country is covered with a superficial deposit of loose sand, which is blown by the wind into large conical hills rendering travelling quite difficult. Numerous freshwater and saline lakes are scattered about among these sandhills, affording a resort for myriads of water birds, ducks, geese, gulls, &c.

August 10th. On reaching the Niobrara we observed some of the Upper Miocene beds exposed in the channel of the river, very rarely, however, containing any organic remains. The more recent upper strata (Pliocene), reveal large quantities of the teeth and bones of mammals, with fragments of a species of turtle (*Testudo Niobrarensis*, Leidy).

Section of beds in descending order:

1. Alluvial and drift.
2. Quite hard arenaceous limestone; the same rock seen on the Loup fork containing cherry-stones. 15 feet.
3. Dark gray friable coarse sandstone. 4 feet.
4. Like bed 3, but more heavy-bedded and less distinctly stratified. 30 feet.

We seem to have represented here the highest bed of the Miocene Tertiary, with a full series of the Pliocene. A butte near our camp affording a fine section of the strata, measured from the edge of the river with a pocket level, proved to be one hundred and sixty-six feet in height. It is composed mostly of a gray calcareous grit, more or less compact, sometimes quite incoherent, containing many seams of concretionary sandstone. On the summit is a stratum formed of loose layers of limestone, similar to that which con-

tains the freshwater shells near Pinau's spring, though holding a higher geological position. Indistinct traces of shells and abundant remains of fishes, as scales, vertebræ, &c., were observed on the surface of tabular masses. It seems to form the upper part of gray sandstone bed E of the general section, and to vary much in its lithological characters in different localities, presenting every variety, from a translucent chalcedony to a fine-grained sandstone or compact limestone, and furnishing those chalcedonic masses which meet the eye of the traveller so often on the surface of this formation, having the appearance of erratic blocks. Further from the river and capping the hills, are beds of yellow and yellowish gray calcareous grit, undoubtedly of Pliocene age, containing numerous fragments of the jaws and finely preserved bones of the Mastodon and Elephant. As we pass up the Niobrara the gray sandstone bed assumes a variety of characters, sometimes forming a coarse conglomerate, then an aggregate of granular quartz cemented with calcareous matter. Lithological changes are constantly occurring in the Upper Tertiary beds. About fifty miles up the Niobrara from the point where we struck it (Aug. 10th), the Pliocene beds cease to appear, and the whole country is occupied by the Miocene formations D and E of the general section.

August 14th. On the distant hills saw large layers of a fine-grained arenaceous limestone, forming a bed ten to fifteen feet in thickness. At this locality we find in bed E, alternations of reddish flesh-colored grit and light ash-colored clay with layers of concretionary sandstone and limestone. Fifty miles above our camp of August 10th, a new bed arises above the water level of the river, composed of a flesh-colored calcareous grit with a reddish tinge. Sometimes it is a light yellow calcareous marl, and the eroded material gives a reddish yellow tint to the whole surface of the country. It seems to pass up quite gradually into the sandstone above. The remains of an animal allied to the *Oreodon*, named by Dr. Leidy, *Meycochoerus proprius*, were collected from this bed at this locality.

August 15th. One of the most characteristic and picturesque instances of the castellated appearance of the Bad Lands on the Niobrara, is seen near our camp. At this point the thickness of bed D is one hundred and twenty-four feet above the river. It has the same general lithological character as in the White river valley, where a much greater thickness is exposed. It contains many layers of silico-calcareous concretions, sometimes forming large ledges, which break into irregular fragments on exposure. The more incoherent material has much the color and composition of the turtle bed on Bear creek, but contains less aluminous matter.

Leaving the Niobrara for Fort Laramie we observe at Spoonhill creek the conglomerate composing a large portion of bed E, giving a very rugged appearance to the scenery. It consists of angular and water-worn pebbles of every variety and color, from the granitic and metamorphic rocks of the Black hills and other mountainous portions, varying in size

from one inch to four inches in diameter, cemented together with a silicious paste. Large masses of this conglomerate have fallen to the base of the hills or are scattered over the plains below. We also pass through a large area covered with sandhills after leaving the Niobrara. These hills all have a dull reddish tinge, evidently from the eroded materials of bed D. One of these hills was one hundred and eighty feet above the surrounding prairie with very steep sides, its present conformation being preserved by the roots of vast numbers of a species of Yucca (*Y. angustifolia*), which cover the hill and seem to attain their maximum growth in the sand. The sandhills are composed of the eroded materials of the different Tertiary beds, and from the loose incoherent nature of the sand, they suffer continual change of form and position by the action of winds.

On Rawhide Butte creek bed D approximates more closely in its character to the Oreodon bed B of the general section, at Ash Grove spring and Bear creek. In the valley of the creek, on an exposed or denuded area not more than eight or ten yards square, I observed fragments of a species of turtle (*Testudo Nebrascensis*) belonging to at least eight individuals, with a few mammalian remains (*Oreodon Culbertsonii*). The Upper Miocene beds occupy the country in the vicinity of Fort Laramie exclusively, and extend to the base of the Laramie mountains. Bed E attains the greatest thickness, having been eroded away to a great extent, while bed D becomes one hundred and eighty to two hundred feet in thickness. The channel of the Platte river cuts through Pliocene and Miocene strata alone from Fort Laramie to longitude 98°, a considerable distance below Fort Kearney.

CHAPTER IV.

GEOLOGY IN THE VICINITY OF FORT LARAMIE.

The plain country in the vicinity of Fort Laramie is underlaid for the most part by the upper members of the White river Tertiary beds. By referring to the Geological map, it will be observed that west of Fort Laramie, between the two main branches, Laramie and North Platte, but two small exposures of the Carboniferous rocks occur. As we proceed westward toward Laramie peak the first exposure is seen near the head of Warm Spring creek, occupying an area of not more than five or six hundred square yards. Its upheaval is probably local, the limestone being revealed by the erosion and removal of Tertiary beds, which are in this immediate region apparently undisturbed, and lie unconformably against the upheaved mass. The limestone strata dip in every direction from a central axis. The fossils are quite abundant, but the hard and brittle character of the rock renders it next to impossible to secure perfect specimens. At the base of the exposure are two or three feet of ferruginous shale, the lower layers of which seem to have been slightly affected by heat

from beneath. The fossils are *Productus*, *Chonetes*, *Spirigera*, probably *S. subtilita*, *Spirifer*, *Retzia mormoni*, *Rhynconella uta*, corals and crinoidal remains. Nine miles farther to the westward we find the Carboniferous rocks again exposed by the wearing away of the Tertiary beds in the valley of Cottonwood creek. Here we have a series of limestone eighty feet in thickness, with a central axis similar to the exposure previously noticed, the strata apparently dipping northeast and southwest at an angle of about 10°, while the Tertiary beds again rest unconformably upon their upturned edges. The lower strata which are exposed in the channel of the creek, have been subjected to considerable heat, so that their color is changed to a brick red.

Along the base of the mountains between the Laramie fork and the North Platte no Carboniferous rocks are exposed; indeed all the older fossiliferous beds are concealed by a recent heavy deposit, consisting of gravel and water-worn boulders, from all the geological formations represented in this region. This superficial deposit extends along the Laramie fork for a considerable distance from the mountains, the Tertiary beds being revealed here and there in the channel of the river. About twelve miles above Fort Laramie, both on the Laramie river and on the Platte, a remarkable deposit was observed, composed of a coarse conglomerate, fifty to one hundred and fifty feet in thickness, of a recent date and evidently accumulated since the rivers occupied their present beds. Indeed the form of the deposit is that of a basin twelve or fifteen miles in length, and reaching its greatest thickness only in the valleys of the rivers, while the elevated ridge between the rivers reveals the true Tertiary beds. The rock seems to vary in structure from an aggregation of particles of quartz or a quartzose sandstone to an exceedingly coarse conglomerate, made up of every variety of material, much of which I have not yet seen in place. It appears to have been formed during the drift epoch, possibly at a later period by the damming up of the two streams near this junction, and the materials were doubtless transported by strong currents from the mountains in the vicinity.

North and northwest of Fort Laramie we observe quite extended areas occupied by Carboniferous limestones with metamorphic and granitoid rocks. These exposures lie along the line of connection between the Laramie range and the Black hills. Surrounding all these exposures and occupying the valleys we see the Upper Tertiary beds, but never conforming to the older rocks. Near Horse-shoe creek along the base of the mountains, the Cretaceous, Jurassic, Carboniferous, and Potsdam formations are exposed, the strata sometimes inclining high upon the sides of the ridges of elevation. The White river Tertiary beds continue up to La Pule, when they gradually give way to the Lignite Tertiary beds, though remnants are still seen farther up the river. Here the White river Tertiary strata rest upon the Lignite beds, showing most conclusively their relative ages.

Southward of Laramie river along the foot of the mountains we have a continuation of

the same rocks exposed in outcropping narrow belts, sometimes expanding so as to occupy a wide area; again concealed or eroded away so that scarcely a trace can be seen. The plain country is occupied by the upper members of the White river Tertiary. The nucleus of the mountains is composed of granitoid rocks with very little variety. I shall dwell more at length on the general geology of this region in a succeeding chapter.

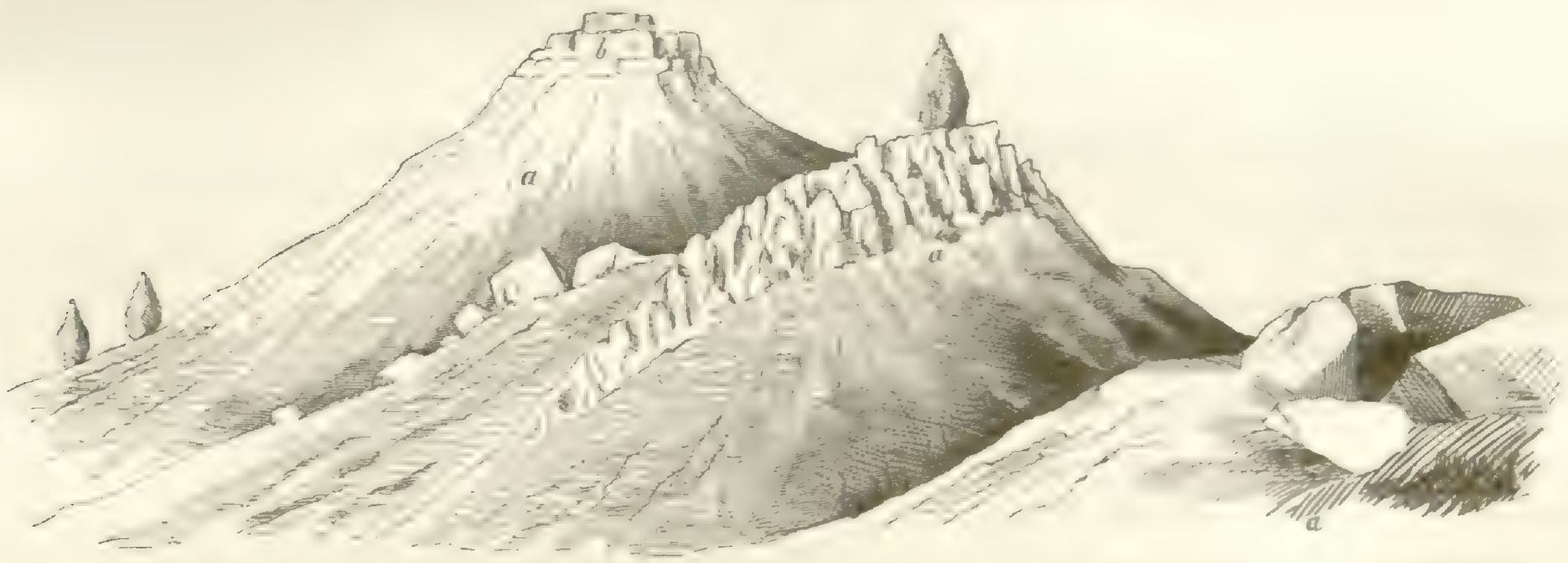
In the Laramie range are beautiful valleys with streams of pure water, margined with birches, poplars, and other trees such as are met with in more northern latitudes. Not unfrequently there are broad level plains with a soil composed of the disintegrated materials of the granitoid rocks, sustaining a good growth of vegetation. The mountains are covered with a fine growth of pine timber, which would furnish an almost inexhaustible supply of lumber for economical purposes.

CHAPTER V.

FORT LARAMIE TO THE BLACK HILLS.

About seven miles north of Fort Laramie, we pass the eastern extension of the Laramie hills, which is composed of numerous centres of upheaval, by which the granite is protruded and the overlying rocks thrown off in every direction. The elevations vary from one hundred to eight hundred feet in height, the nucleus formed of granitic and azoic rocks, while the Carboniferous limestones are scattered over the sides or base of the upheaved masses, or lie unconformably upon their summits. The Carboniferous limestones incline at various angles, depending upon the power of the disturbing force from beneath,

Fig. 4.



and when unchanged by heat contain a few fossils. We can here see every variety of the limestone, from the unchanged fossiliferous, to the completely metamorphosed rock, with the indications of stratification nearly or quite obliterated. Sometimes the melted ma-

terial is thrust up through the seams in the unchanged mass, so that in a single hand specimen we have the changed and unchanged rock. Not unfrequently the limestones are elevated in such a manner that the strata preserve their horizontality very nearly; again they dip at an angle of from 5° to 30°.

The above sketch, taken by Lieut. Warren, about six miles north of Fort Laramie, exhibits some of the phenomena just mentioned. *a*. Represents metamorphic rocks distorted at different angles. *b*. Strata of Carboniferous limestone capping the summit of the upheaved peak and still retaining their horizontal position.

Passing from the Platte toward the Niobrara, the upheaved ridges seem to tend in a northerly direction, and are for the most part capped with limestones in a more or less changed condition. At the foot of these ridges the upper beds of the Tertiary may be seen insinuating themselves into the valleys and ravines or deposited high up on the sides of the elevations, thus, as it were, filling up to some extent the inequalities of surface formed by the upheaval. In all cases the Tertiary beds are undisturbed and not unfrequently rest directly upon the vertical edges of the azoic stratified or granitic rocks. Rawhide peak is about eight hundred feet high and of the same geological character as Laramie peak. High upon its sides may be seen remnants of the Tertiary beds, left after denudation; showing very clearly that all these elevations and ridges once formed rocky islands in the great Tertiary lake.

Near Rawhide peak the quartzose limestone appears again in a more or less disturbed condition. A section across the vertical edges of the strata would stand thus:

1. Quartzose limestone with stratification nearly or quite obliterated.
2. Laminated clay slate.
3. Alternate strata of Gneiss, Hornblende, &c.

Directly west of Rawhide peak we have the greatest thickness of stratified azoic rocks met with on the trip. The strata were vertical and I could obtain a section only across the upturned edges.

1. Carboniferous limestone. 100 to 300 feet.
2. Quartzose arenaceous limestone. 150 feet.
3. Soft bluish clay slate. 15 feet.
4. Very compact quartzose arenaceous limestone. 500 to 700 feet.
5. Steel gray Hornblende. 30 feet.
6. A compact crystalline limestone with a somewhat fissile structure which gives it the appearance of being laminated, breaking into large rhomboidal masses. 80 to 100 feet.
7. Steel gray gneissoid slate with veins of white quartz disseminated through it. 150 feet.
8. Very hard gneissoid rock. 80 to 100 feet.

The Carboniferous limestones at this locality present a peculiar appearance not unlike the fused and semifused strata overlying the burned lignite beds on the Yellowstone. The fused masses are very compact and heavy, varying in composition, red, yellow, and mottled, oftentimes containing small fragments of partially changed rock, thus forming a kind of conglomerate. These appearances are more fully illustrated about eight miles west of Rawhide peak, where there is a vertical wall of limestone which exhibits every variety of character which we have mentioned. After leaving this ridge we descend into a valley stretching off to the northwest, and into every ravine the Tertiary beds seem to have penetrated or to have been deposited high upon the sides of the ridges.

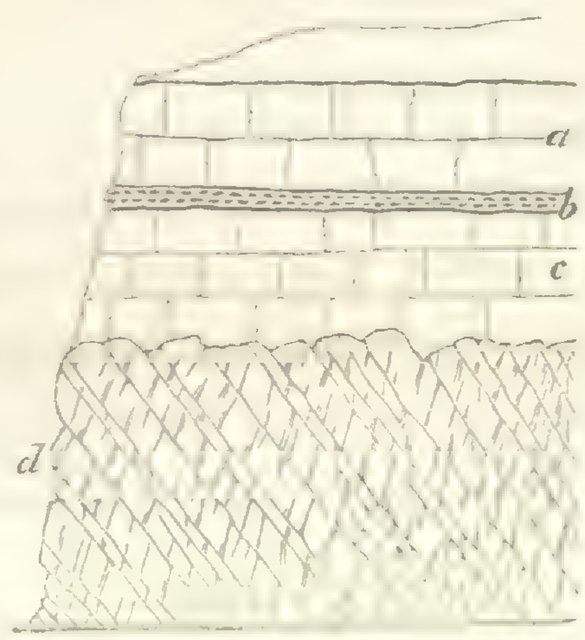
Fig. 5.

In the above wood-cut, *a* represent the azoic rocks upheaved in the form of conical peaks; *b*, the Tertiary beds deposited in the valleys and jutting against the older rocks on all sides.

At the head of Niobrara river we have indications of upheavals, but to a limited extent, near our camp, in the following section, the unchanged sedimentary strata lie unconformably on the vertical edges of the metamorphic rocks.

After crossing the Niobrara the Tertiary beds occupy the country with the exception of a few isolated exposures of Carboniferous limestone. Passing the dividing ridge between the Niobrara and Shyenne rivers into the valley of Old Woman's branch, we find that the Tertiary rocks by erosion assume a

Fig. 6.



a. Quartzose sandstone. 22 feet.

b. Red argillaceous slate. 5 feet.

c. Yellowish sandstone with reddish tinge. 37 feet.

d. Metamorphic and granitic rocks. 80 to 100 feet.

variety of fantastic shapes, such as domes, towers, and spires, one of which seems to be twenty or thirty feet high, but not more than four or five feet in diameter at its base. From this pillar the little tributary of the Shyenne derives its name. Very little timber is seen along our route excepting a few scattered pines among the hills.

On the north side of Old Woman's branch is a high ridge ranging northwest and southeast, composed of a variegated sandstone varying in structure from a compact fine silicious rock, to a coarse reddish conglomerate or sandstone, with no fossils but indistinct traces of vegetable remains. This ridge is the result of a gentle upheaval and is exposed by the erosion of the more yielding Tertiary beds from the valley. On the distant hills on each side of the valley the naked Tertiary beds are visible, while near the bed of the stream the Titanotherium bed is found with its usual lithological characters and containing bones and teeth of the animal from which it derives its name. The following section of the strata in descending series will show the details of this upheaval:

1. Layers of white oolitic limestone, doubtless Tertiary.
2. Compact ferruginous sandstone. 80 feet.
3. Yellow friable sandstone. 2 feet.
4. Light gray fine clay. 4 feet.
5. Yellowish white sandstone, quite friable. 5 feet.
6. Drab or ash-colored indurated clay passing down into red clay. 6 feet.
7. Variable incoherent clays, red, yellowish, &c , which may be of Jurassic age. 50 feet.

Passing down the valley of the Shyenne, the Tertiary beds disappear and the Cretaceous formation No. 5 occupies the country. At one locality an upheaval was observed exposing all the subdivisions of the Cretaceous rocks, as will appear from the following section:

No. 5. Presenting its usual lithological characters with numerous fossils; strata but slightly disturbed. 100 to 150 feet.
No. 4. Presenting the same characters as on the Missouri river. 100 feet.
No. 3. " " " " " " 150 feet.
No. 2. " " " " " " 200 feet.
No. 1. " " " " " " 250 to 300 feet.

No. 5 is but slightly disturbed as will be seen by examining the illustrative section. Nos. 4, 3, and 2, present only their vertical edges of their strata across which the above measurements were taken. The strata of No. 1 seems to have been elevated so as to retain a nearly horizontal position. No. 3 at this locality contains numerous fossils, the most abundant of which are *Ostrea congesta*, and *Inoceramus problematicus*. This bed does not present altogether the same lithological character as on the Missouri river, but pos-

sesses a more laminated and arenaceous structure, sometimes approaching to a calcareous sandstone.

Leaving this locality, we continue to pass over No. 5, and scattered over the surface of the ground are numerous fossils, loose or in argillaceous concretions, as *Inoceramus*, *Baculites*, *Ammonites*. About five miles north of our last night's camp, near the source of the south fork of the Shyenne, a few beds of the lignite Tertiary basin were observed.

1. Yellow arenaceous bed, holding the same position, I think, as the one at Fort Clark, which contains numerous freshwater shells.
2. Light gray grit, with numerous iron rust concretions, same bed seen on Cherry creek, at Fort Clark, on the Missouri above Fort Union and on the Yellowstone. 20 to 30 feet.
3. Very impure lignite. 4 to 6 feet.
4. Dark ash-colored clay passing up into lignite. 20 feet.
5. Fine yellow sand about 6 feet exposed.

These Tertiary beds rest conformably upon cretaceous formation No. 5, and no disturbance was observed in this locality.

Crossing the Shyenne on our way northward, we have the commencement of a series of ridges of upheaval, which surround the Black hills. As we approach the southern base of the Black hills, the strata dip very nearly to the southeast. No. 1 does not appear, but we have a fine development of No. 2, possessing its usual characters, a plastic clay with ash-colored arenaceous concretions and an abundance of well-preserved fossils. No. 3, with large quantities of *O. congesta*, and *I. problematicus*, in an exceedingly comminuted condition, No. 4 also appears, and No. 5 caps the hills on all sides. Nos. 2 and 3 are revealed only by the upheaval. On a branch of Beaver creek we find No. 2 one hundred and fifty to two hundred feet in thickness, and exhibiting its lithological characters in full; first, the summit is composed of ferruginous and gray laminated sandstone containing *I. problematicus* and fragments of fishes, seeming to form a bed of passage from No. 2 to No. 3, 6 to 10 feet in thickness; then, alternate thin layers of gray sand and black shaly clay, with an occasional seam one inch to six inches in thickness of ferruginous sandstone, the whole passing down into a black plastic clay, precisely like that which forms No. 2 on the Missouri river.

We ascend, therefore, to the Black hills by a series of steps or upheaved ridges gradually increasing in height as we approach the central ridge, and the strata more nearly approaching a vertical position. The first step or ridge is, perhaps, fifty to eighty feet in height, revealing Nos. 4 and 5; the second shows Nos. 4 and 3; third, Nos. 3 and 2, and so through all the series of strata until we come to the Potsdam sandstone resting unconformably upon the metamorphic rocks.

In order that my remarks in regard to the Black hills may be more clearly understood, the following general vertical section of the different beds is given, showing their order of succession and approximate thickness. A more detailed survey would doubtless reveal facts which would modify it to some extent, but I believe that it will show the order of superposition of the different strata with sufficient accuracy and detail for our present purpose.

General Section of the Geological Formations seen in and near the Black Hills (descending).

1. Miocene beds consisting of whitish clays and sandstones of various thickness.

Cretaceous System.

No. 5. Of the Nebraska general section, with its usual characters and fossils. 150 feet.

No. 4. Presenting its usual characters and containing its characteristic fossils. 150 feet.

No. 3. Usual fossils and composition. 150 to 200 feet.

No. 2. Usual lithological characters and fossils with some new forms. 200 to 250 feet.

No. 1. Upper part yellowish and reddish sandstone, sometimes in heavy beds, passing down into alternations of yellowish, gray, bluish, and reddish laminated shale, with seams and layers of dark carbonaceous matter, or impure lignite; beneath which there is a heavy bed of compact yellowish and reddish sandstone, with indistinct vegetable remains, and much fossil wood. Above beds variable at different places. 300 to 400 feet.

Jurassic System.

A. Then come alternations of light gray argillaceous grit and soft sandstone, containing *Ammonites Henryi*, and a small oyster; also in bluish gray compact argillo-calcareous masses, *Unio nucalis*, and a small *Planorbis*, with other small univalves like *Paludina*. Layers of argillo-calcareous, somewhat gritty mass, containing *Belemnites densus*, *Ammonites cordiformis*, *Avicula* (*Monotis*) *tenuicostata*, *Arca* (*Cucullæa*) *inornata*, passing down into a 6 or 8 foot bed light gray or yellowish sandstone, with ripple-marks and trails of marine worms. 50 to 80 feet.

B. Light red argillo-calcareous bed, with greenish seams and nodules (sometimes wanting). 30 to 40 feet.

C. Soft gray and dark brownish sandstone passing down into about 8 feet of laminated shale of various colors, below which there is a 6 foot bed of sandstone similar to that above, containing *Avicula tenuicostata* and trails of marine worms. Then comes 30 to 40 feet of bluish or ash-colored argillaceous shale, with great numbers of *Lingula brevirostra* and *Serpula*. Next we have a light gray calcareous grit, containing columns of *Pentacrinus asteriscus*, *Avicula tenuicostata*, *Serpula*, &c., the more compact and calcareous portions often perforated by *Pholas?* the latter bed passes down into a light, yellowish gray sandstone, splitting into thin layers, and containing imperfect casts of *Mytilus* (*Modiola*), *Pecten*, *Trigonia*, and other bivalves in considerable numbers. Whole 60 to 100 feet.

Carboniferous. Red Arenaceous Deps.

D. Brick-red, incoherent, argillo-calcareous, very fine, slightly gritty material containing great quantities of gypsum in the form of seams, layers, and irregular beds. 100 to 150 feet.

E. Bluish and reddish gray, very hard, gritty limestone, in which were found a smooth *spirifer* like *S. lineatus*, two or three species of small *Pleurotomaria*, two species of *Macrocheilus*, and one or two species of *Bellerophon*. This bed is variable in thickness. 10 to 50 feet.

F. Brick-red material, very similar to the bed D, excepting that it contains much less gypsum; passing down into a very hard compact concretionary sandstone. 250 to 300 feet.

G. Hard, more or less gritty, yellowish and whitish limestone, containing *Productus*, *Spirifer*, *Euomphalus*, &c., &c., passing down into a light yellow calcareous grit. Altogether 50 feet.

H. Very hard reddish gray limestone, containing *Syringopora*, *Productus*, *Terebratula*, &c. In the middle of this bed there is an 8 foot layer of very hard compact bluish limestone filled with comminuted crinoidal remains. 50 feet.

Silurian. { I. Potsdam sandstone (oldest Silurian) containing *Lingula*, *Obolus*, and fragments of *Trilobites*. 30 to 50 feet.

J. Highly metamorphosed strata standing vertical.

K. Coarse feldspathic granite, forming mountain masses.

As we approach the loftier ridges of the Black hills, we find them capped with an immense thickness of very variable sandstone, which doubtless belongs to Lower Cretaceous formation No. 1, though it may pass down into Jurassic strata. No fossils were observed in it, excepting traces of uncharacteristic vegetable impressions with fragments of wood. One of these ridges by barometrical measurement was found to be thirteen hundred feet high, covered with pines and forming a portion of the Black hills proper. On the east side of the ridge the strata of sandstone slope gently down to the base; but the west side is abrupt, revealing the edges of the different beds, so that we see the sandstone before mentioned as attaining so great a thickness, passing down into alternate layers of gray sandstone and clay; containing fossils of the genera *Ostrea*, *Ammonites*, &c., with a freshwater deposit composed of a calcareous grit, with hard, dark-gray concretions containing fossils of the genera *Unio*, *Planorbis*, &c. Then comes a series of alternating beds of gray and red grits, and sandstones with numerous fossils of Jurassic types. In but one locality was any lignite observed in No. 1. Two seams were noted, one of them two to four feet in thickness, the other, six to eight feet, alternating with variable grits.

Near the head of Beaver creek on the west side of our road, we observed a ridge about four hundred feet in height, running northwest and southeast, presenting a nearly vertical front, the different beds of which appear to be undisturbed; but looking upon the opposite side, we find that the strata dip towards the prairie below at an angle of 20° to 30°. This ridge is composed of a great thickness of No. 1, passing down into variegated clays and grits one hundred to a hundred and fifty feet in thickness, from which I obtained *Ammonites*, *Belemnites*, and other fossils of Jurassic types in great abundance. Pursuing our course eastward, we passed through a valley between two of the upheaved ridges which surround the Black hills. In this valley we observed a bed of bluish ash-colored limestone (E of vertical section), which presents many peculiarities from the disturbing influences which have elevated this portion of the country. Sometimes it forms over large areas a sort of tessellated pavement from the peculiar fracture of its surface; again, it is puffed out, as it were, forming rounded protuberances thirty to sixty feet in height, the external surface yielding so as to adapt itself to any inequalities. It thus holds a great variety of positions. All along the valleys and on the hills are large exposures of the brick-red grit bed D, with intercalated seams of gypsum varying in thickness from one inch to four or five feet. In one instance I saw a local bed of gypsum twenty feet in thickness.

Our course to-day led us over a bed of blue limestone from the head of Beaver creek to Inyan Kara Paha or Stone peak. Scattered throughout the valley and over the hills are the incoherent materials of the brick-red grit beds, giving to the country a most picturesque appearance. Stone peak is chiefly composed of basalt, which at this locality assumes a columnar form similar to the columnar trap in the Lake Superior region. The rock is usually of an ashen-gray, sometimes becoming an iron-rust color, with much the texture of granular sandstone. A portion of the rock forming a lower ridge, but more recent, is trachytic, retains its stratification, has a much lighter color and a more porous structure.

We remained in our camp three days, surrounded by a wall of blue limestone, which has been disturbed in every conceivable way, yet seeming to adapt itself with wonderful flexibility to all the inequalities of the surface; sometimes it paves the valleys or the lower plains, again it seems to be wrapped about some conical hill like a garment. As cut through by the little stream near our camp, it varies in thickness from twenty-five to thirty feet, becoming yellowish on exposure. Many portions of it have a fine silicious or cherty structure. The following section will show the different beds seen in this vicinity in descending order.

1. Yellowish gray argillaceous grit.
2. Light-red incoherent sand and clay. 30 feet.
3. Laminated bluish clay shale. 8 feet.
4. Gray and grayish-brown sandstone. 6 feet.
5. Bluish ash-colored argillaceous shale, with *Avicula* (*Monotis*) *tenuicostata*, *Lingula brevirostris*. 30 to 40 feet.
6. Compact blue limestone, not fossiliferous at this locality. 25 to 30 feet.

Near the head of Beaver creek bed 2 of the above section presents the following layers: Gypsum 15 feet, passing down into 25 feet of red argillaceous grit; then 20 feet of gypsum; then incoherent brick-red grit, passing down into a heavy-bedded sandstone. 40 feet.

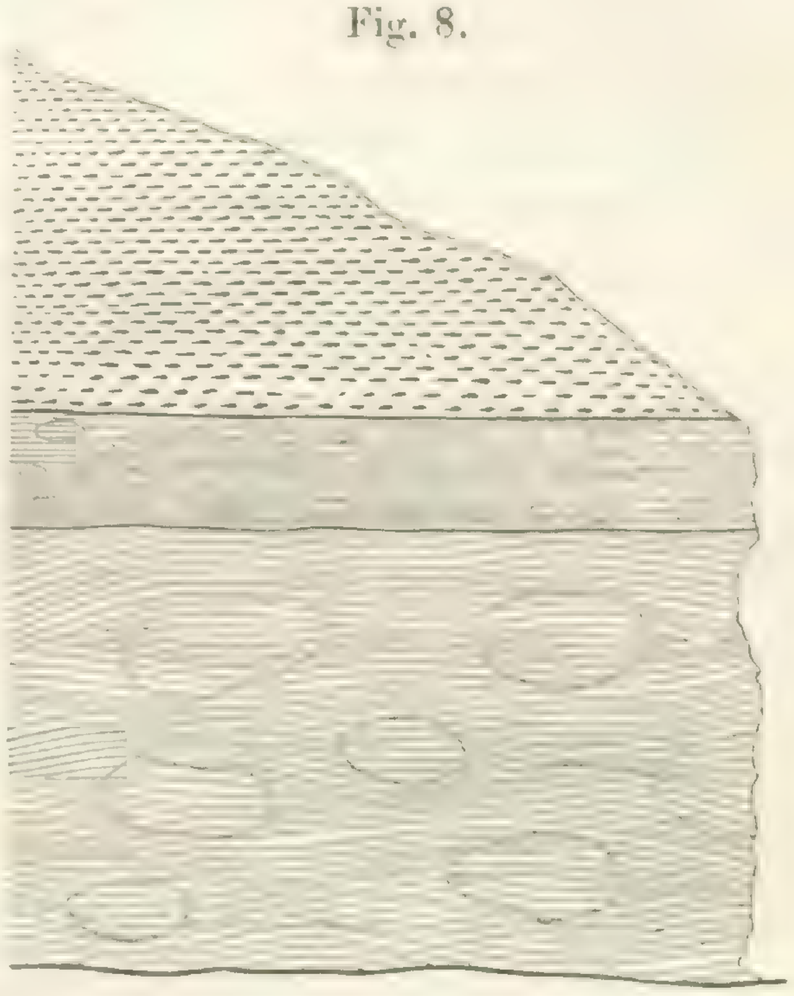
Fig. 7.

On our route to-day the blue limestone bed was very conspicuous, attaining a thickness of forty or fifty feet, presenting many peculiarities. Portions of it are made up of thin laminæ, which by pressure, when the materials of which the bed is composed were in a yielding state, have become very much contorted. These flexures in the laminæ have been quite common throughout our day's march. In some localities this bed contains many fine compact silicious nodules from which the laminæ seem to bend each way, so as to clasp them,

as it were. The streams cutting through this bed in various directions have formed deep cañons with perpendicular sides, rendering travelling quite difficult.

The valleys in the Black hills are quite picturesque from the incoherent character of the materials of the brick-red bed, which are strewed everywhere. On the hills I find the following beds represented:

Fig. 8.



1. Gray sandstone. 30 feet.
2. Yellowish, laminated, argillaceous shale, with numerous fossils. *Avicula* (*Monotis*) *tenuicostata*, *Lingula brevirostris*, *Pentacrinus asteriscus*, and many specimens of *Vermetes*, &c. 20 feet.
3. Dark bluish ash colored shale, with fossils same as in last bed. 30 feet.
4. White sandstone passing down into a red, coarse-grained, heavy-bedded sandstone. 50 to 80 feet exposed.

The sandstone which caps the hills is often broken into immense tabular masses, the surfaces of which are covered with trails of Planarian worms or mollusks, also impressions of raindrops and waved ridges such as are often seen on the shore of a stream.

We passed to-day over the brick-red bed beneath the blue limestone, both of which are fully represented. This lower bed, F, of the vertical section, which is so conspicuous in our day's march, is most variable in its character and color, changing from a nearly white to a deep red color, and from a friable grit to a compact silicious rock; sometimes it becomes a conglomerate composed of nodules and slightly worn fragments of flint rock, apparently from the Carboniferous rocks beneath. Eight miles before reaching our camp of September, we met with the true Carboniferous limestones for the first time, though they are everywhere revealed near the central portions of the Black hills. First an arenaceous limestone is seen, then a bluish limestone with cherty nodules like bullets, and a few characteristic fossils. The sandstone which we have before mentioned as so variable seems to rest conformably on the Carboniferous rocks, though all the beds are more or less distorted. When the Carboniferous rocks appear, the country becomes much more rugged and uneven, being elevated into high ridges, from the sides of which the different strata of limestone project and incline at all angles.

We remained during the day in the central portion of the Black hills. Here we find the Carboniferous rocks and the Potsdam sandstone conforming to each other and resting unconformably upon the metamorphic rocks. No rocks more recent than the Carboniferous

were observed in this locality. The following section represents the different beds in descending order:

1. A hard compact fine-grained yellowish limestone, of an excellent quality, passing down into a yellow calcareous sandstone somewhat soft and friable. Fossils: *Spirifer Rockymontana*, *Spirigera* like *S. subtileta*, *Cyrtoceras*, &c. 50 feet.
2. Loose layers of very hard yellow arenaceous limestone with a reddish tinge; then a bed 6 to 8 feet in thickness of very hard blue limestone, passing down into a repetition of loose layers of yellow arenaceous limestone. The whole contains vast quantities of comminuted crinoidal remains with corals and several species of *Brachiopoda*. 40 feet.
3. Variegated calcareous sandstone, gray and reddish quartzose with particles of mica. Some portions are very compact and silicious, others a coarse friable grit, others a conglomerate. Fossils: *Lingula prima*, *Lingula* undetermined, *Obolus* and fragments of Trilobites. 30 to 50 feet.
4. Metamorphic rocks standing in a vertical position for the most part.

The main ridge of upheaval seems to have a bearing about 40° west of north. The principal ridges appear to be nearly parallel, but the smaller upheavals cannot be brought into any system. I think the red granite at this locality contains more mica than usual, and might therefore be called micaceous granite. In other respects it presents much the same characters as that which forms the main body of Laramie peak and Rawhide peak. Here also we noticed a bed of clay or talcose slates, eight to ten feet in thickness, attached to and passing down into the granitic mass. Alongside of the slate, and evidently of more recent origin, is a bed of compact silicious rock, with stratification distinct, and differing very little from the quartzose rocks seen on the Platte.

The Potsdam sandstone presents a great variety of lithological characters. In many localities it assumes the form of a conglomerate of more or less water-worn pebbles, mostly whitish crystalline quartz, but representing every variety of the metamorphic rock beneath. The pebbles vary in size from an eighth of an inch to four inches in diameter, but the greater part are from one half of an inch to two inches in diameter, cemented together with quartzose sand. Some of the pebbles are scarcely worn, others are perfectly smooth. At the locality where the last section was taken, the sandstone is of a gray color, tinged with red at the base; but, passing up, it becomes more ferruginous until its color is a dark red, and its texture a coarse-grained friable sandstone, with many quartzose and micaceous particles and some calcareous matter. Seams two to four inches in thickness are very nearly composed of comminuted fragments of shells, comparatively few being sufficiently perfect to be identified.

The metamorphic rocks were not altogether vertical to-day, but dipping at an angle of 70° to the southeast. We travelled about nine miles through the metamorphic rock, Potsdam sandstone and Carboniferous limestone. A section taken on the southeastern

base of the Black hills represents some local changes that occur in the Carboniferous. Dip of strata 20° south of east.

Carboniferous System.

1. Deep yellow limestone with fossils. 60 feet.
2. Yellow argillaceous shale. 18 inches.
3. Compact yellowish cherty rock. 4 feet.
4. Light yellow argillaceous shale. 6 to 12 feet.
5. Very compact limestone with cherty nodules. 8 feet.
6. Alternate seams of yellow and drab arenaceous shale, tinged with red. 4 feet.
7. Reddish calcareous sandstone. 12 inches.
8. Very tough argillaceous limestone passing down into soft friable sandstone or Potsdam sandstone. 2 feet.

At another locality near the point where the last section was taken an upheaval shows the following beds:

1. Alternate layers of yellow and dark brown arenaceous shale and sandstone with fossil wood. 50 to 60 feet.
2. Whitish rather fine-grained sandstone. 15 feet.
3. Reddish gritty marl passing down into a yellow shaly arenaceous marl. 50 feet.
4. Yellow and yellowish gray sand and sandstone. 30 feet.
5. Red grit with layers of concretionary sandstone. 30 feet.
6. Layers of yellow arenaceous material, alternating with sandstone and shale. 40 feet.
7. Red grit with layers of reddish sandstone, but comparatively little gypsum. 50 to 80 feet.

Bed 1 belongs to Lower Cretaceous formation No. 1 of our general section; the others are undoubtedly Jurassic strata.

Leaving our camp near the central ridge of upheaval of the Black hills, and taking a southeasterly course toward the Shyenne river, we pass over; first, metamorphic rocks; second, Potsdam sandstone; third, a belt of Carboniferous rocks, about three miles in width; fourth, a belt of Jurassic strata, about eight miles in width; fifth, a complete series of the cretaceous formations ten to fifteen miles in width; and in the distance beyond the Shyenne the white clays and marls of the White river Tertiary basin could be seen.

Passed over metamorphic rocks and Potsdam sandstone for the most part. The latter assumes an unusual conglomerate character, and the exceedingly comminuted condition of the organic remains, together with the irregularity of the laminæ, indicates that this rock was deposited in shallow and turbulent water.

Our route to-day led us over Jurassic beds chiefly. At one locality a yellowish blue arenaceous shale, below bed B of vertical section, contained layers of rock six to eighteen inches in thickness, composed of an aggregation of shells of the genera *Ostrea*, *Belemnites*, *Avicula*, and many undetermined species, the whole very much broken up. The entire thickness of this bed is eighty or ninety feet, with the greatest abundance of organic remains distributed through it.

Ascended Bear peak, which is a solitary upheaval in the plain near the north fork of the Shyenne, and seems to be cut off from the main portion of the Black hills by a valley about six miles in width. The strata which underlie the surface of this valley are more or less disturbed. Bear peak is composed entirely of trap rocks, no granite being seen, and is evidently a protrusion or outburst of igneous rocks. Much of the rock is very porous trachyte; portions of it are more compact, breaking into irregular fragments, producing a peculiar ringing under the blows of a hammer like clinkstone. This rock also has a gritty structure, sometimes a dark gray or bluish gray color. Immense quantities of broken rocks cover the sides of the peak to the depth of twenty or thirty feet; the strata are vertical, or nearly so, and the ridges of upheaved Cretaceous and Jurassic beds which surround the peak in nearly a circular form, gives to the whole a crateriform appearance. The lowest unchanged rock exposed by this upheaval is the blue limestone bed *E* of the vertical section, then, alternate beds of red and yellowish gray argillaceous grits, shales, and sandstones are revealed, containing great quantities of Jurassic fossils. From the summit of the peak at a distance of twenty or thirty miles towards the north, the Deer's Ears and Slave butte are visible, and though the country in the vicinity is underlaid by Cretaceous formation No. 4, these hills are, I am confident from their appearance, composed of the sands and clays of the Lignite Tertiary, monuments left to indicate that the Tertiary beds once covered the surface of the country in that region. From the valley on the south side of Bear peak we ascend to the Black hills by a series of step-like ridges, composed of a full series of the Cretaceous, Jurassic, Carboniferous, Silurian, and metamorphic strata, with here and there protrusions or outbursts of igneous rocks. In one locality basaltic columns similar to those forming Stone peak were observed, some lying in nearly a horizontal position, others dipping at an angle of 20° to 40°. These columns are five-sided, the sides varying from eight to twenty inches in width. The rock is quite hard and compact in its structure, not differing from that which enters into the formation of Stone peak.

Near Beaver Creek, formation No. 2 is very largely developed, presenting its usual lithological characters, and containing great quantities of fragmentary fish remains, but no other fossils. No. 1 in this vicinity is composed of variegated clays, grits, and sandstones, with indistinct vegetable impressions, fossil wood, and a few uncharacteristic saurian bones. No. 3 is also exposed by the upheaval of the beds, containing its usual fossils, but possessing the character of a laminated calcareous sandstone, instead of the soft homogeneous calcareous marl of the Missouri river.

CHAPTER VI.

FROM BEAR PEAK TO FORT RANDALL ON THE MISSOURI RIVER.

October 3d. Travelled eighteen miles in a southeasterly direction over Cretaceous beds Nos. 2 and 3. All the upland prairie surrounding the base of the Black hills is covered with a heavy deposit of drift.

October 4th. Our route to-day led us over Cretaceous bed No. 4. Camped at night on the Shyenne river opposite the mouth of Sage creek. Found vast quantities of finely preserved fossils, *Ammonites*, *Baculites*, *Scaphites*, *Ostrea*, and many undescribed species. In the distance eastward the naked columns of the Bad Lands are seen quite conspicuously.

October 5th. Ascending the valley of Sage creek we pass over a blending of Cretaceous beds Nos. 4 and 5 for the first five miles, which contain an abundance of fossils similar to those found on the Shyenne yesterday. We then meet with the lowest bed of the great Tertiary basin of White river, resting conformably upon the Cretaceous strata. We have first the dark clays of No. 4, then the yellowish brown arenaceous shale of No. 5, with numerous ferruginous concretions; then, the Titanotherium bed, which sets regularly upon No. 5, and reaches its greatest development in the valleys of Sage and Bear creeks. It is there composed first of a band of argillaceous grit, weathering to a pink color, two feet in thickness, passing up into an ash-colored plastic clay, with a greenish tinge, full of chalcedony and calcareous concretions; third, a light-gray calcareous grit, upon which rests the turtle bed, the whole thickness being from 80 to 100 feet. A considerable deposit of water-worn boulders and fine sand is distributed over the surface of the Bad Lands to a greater or less extent.

October 6th. Passing up the valley of the Shyenne, we see only the Cretaceous beds Nos. 4 and 5, with many fossils, until we are beyond the mouth of Bear creek, when the Tertiary makes its appearance, crossing the Shyenne and stretching off toward the base of the Black hills in long ridges or isolated buttes. The drift material resting upon the Cretaceous rocks along the river sometimes attains a thickness of ten or fifteen feet.

October 7th. The bed of Tertiary on the left side of the Shyenne river is about thirty miles in width. A section about fifteen miles above the mouth of Bear creek, on the left side of the Shyenne, presents the following strata:

Titanotherium Bed.
1. Light gray indurated clay. 6 feet.
2. Seam of gray sandstone. 18 inches.
3. Ash-colored plastic clay with a greenish tinge, and a pinkish band of fine grit at the base. 30 feet.

The Titanotherium bed varies much in its lithological characters in different localities. The layer of gray sandstone is sometimes two to four feet in thickness, composed of an aggregate of water-worn pebbles with granular quartz and small particles of mica, forming somewhat conspicuous ledges. On the western side of the Shyenne the Titanotherium bed presents the following characters, proceeding upward from No. 5: First, alternate seams of small pebbles and sand, two to six inches in thickness, passing up into a fine ferruginous grit containing small plates of mica, weathering to a light gray color; then a band of pinkish gritty clay six inches in thickness, passing up into an ash-colored clay, which has also alternate arenaceous layers. The pinkish band is quite persistent, and being exposed wherever the T. bed is worn through, marks with a great deal of precision the base of the Tertiary. The surface in many places is covered with well-waterworn pebbles varying in size from a granule of quartz to a rounded boulder eighteen inches in diameter, though the pebbles are mostly small, representing all the varieties of metamorphic rocks with fragments of silicified wood, rounded masses of limestone and flint, and indistinct organic remains, so that the surface of No. 5, when the T. bed is eroded away, is paved with these stones. Sometimes the pebbly bed is twenty feet in thickness. The turtle bed above does not seem to be so marked in its character here as at Bear creek. It weathers to a light yellow color and passes almost insensibly into the bed above. I have indicated the line of separation at this locality between the turtle bed and the overlying stratum by a layer of very porous argillaceous sandstone of a dull brown or drab color. The turtle bed contains much more sand at this point than at Bear creek, and the upper portion consists of alternate layers of calcareous concretions and indurated argillaceous grit, with one band eight feet in thickness of ash-colored clay. Disseminated all through the bed in every direction are thin seams of silex in the form of chalcedony. A few organic remains were obtained, mostly of *Oreodon* and *Rhinoceros*.

On the right or east side of the Shyenne as we proceed toward White river, the Cretaceous bed No. 5 presents some peculiarities which are worthy of notice. We have, first, No. 4, black clay, laminated, gradually passing up into a dark brown clay; then a deep ferruginous color; then a dull purplish hue, with red iron rust seams, half an inch to an inch in thickness, passing up into a deep yellow arenaceous clay; lastly, a brown clay, underlying the Titanotherium bed. I have been thus minute in describing these beds from the fact that, although a long period must have elapsed after the close of the Cretaceous, and prior to the deposition of the Tertiary, the transition to the Tertiary epoch from the Cretaceous does not seem to be marked by any conspicuous physical break, but by a gradual change of sediments. We know, however, from observations at other localities that the Cretaceous surface was more or less subjected to erosion prior to the deposition of the Tertiary beds of this region.

At another locality the Titanotherium bed at the base consists of clay with a pinkish tinge filled with angular grains of quartz and water-worn pebbles, two feet; then a loose, incoherent gravel with pebbles three to four inches; then six to eight feet of light gray clay filled with pebbles and angular grains of quartz, sometimes forming a quartzose sandstone, passing up into a dark ash-colored clay with a greenish tinge.

October 8th. Between the Shyenne and White rivers, running through the turtle bed, is a seam of fine blue grit, vertical to the rest of the strata. A large number of these curious seams occur at different localities, which, doubtless, are caused by fissures in the strata being filled with a fine sediment by infiltration. A section of the different beds in descending order at this locality would be—

Oreodon Bed. Bed.
1. Flesh-colored marl. 10 feet.
2. Bluish laminated clay with a yellowish tinge. 2 feet.
3. Flesh-colored indurated marl. 15 feet.

4. Light gray, indurated argillaceous grit, forming a conglomerate of nodules of clay. 4 to 6 feet.

Oreodon Bed. Bed.
5. Flesh-colored indurated grit. 20 feet.
6. Bluish argillaceous grit. 10 inches.
7. Flesh-colored marl. 4 feet.
8. Argillaceous grit. 6 to 12 inches.
9. Flesh-colored marl. 30 feet.

Titanotherium Bed.
10. A fine light gray calcareous grit passing down into an ash-colored clay, with micaceous and silicious sandstone at base tinged with a purplish hue. 80 to 100 feet.

11. Cretaceous beds Nos. 5 and 4.

In the valley of White river the Cretaceous beds Nos. 5 and 4 are exposed by the erosion and removal of the overlying Tertiary strata. No. 5 contains numerous fossils in similar tough argillaceous concretions to those observed on the west side of the Shyenne. All the calcareous matter has been dissolved away from the fossils, leaving only casts. The upper portion presents a variety of lithological characters and is destitute of fossils.

Section of Tertiary beds on White river near camp. October 9th:

1. A calcareous grit, the lower portion seeming to contain more sand and less calcareous matter than the upper. At this point it has a thickness of about 40 feet, with 40 to 50 feet of Post Pliocene marly grit capping it, containing numerous freshwater shells identical with living species, like the Loess or Bluff marl near Council Bluffs. A few fragments of turtles and bones and teeth of *Oreodon* were found in this bed. Bed C, Upper Miocene.
2. Variegated bed, consisting of alternate layers of dark brown clay and light gray calcareous grits, of which I counted twenty-one at this locality, varying in thickness from one inch to two feet. 20 feet.
3. Deep flesh-colored marl, contains many concretionary layers of light gray sandstone, which gives the bed a banded appearance when weathered. The abundance of organic remains commences in this bed and ceases at the first dark band at the base of bed 6 above. This bed becomes much more arenaceous towards the base. The lower half contains five layers of concretionary sandstone from four inches to two feet in thickness. 48 feet.

The above section was taken some distance from the river, and the slope prevented me from continuing the section through the Titanotherium bed to the Cretaceous strata which are exposed in the channel of the river.

October 10th. Leaving the valley of White river we proceeded in nearly a southeast course, ascending gradually to the dividing ridge between White and Niobrara rivers, where we find the largest development of bed D, which exhibits its usual lithological characters, but contains very few fossils. This bed has been eroded so that the surface of the country occupied by it is covered with conical hills, which are often capped with a considerable thickness of loose material, sand or marl. A similar configuration of the surface forms the basis of the sandhills, and the wind accumulates the loose sand around the summits of the hills.

October 11th. Leaving Wounded Knee creek we begin to meet with indications of the Pliocene beds, which are so well developed on Loup Fork, Platte, and Niobrara rivers. A conical hill, left after the erosion of the surface around, reveals 42 feet of light gray and greenish gray fine calcareous grit, containing numerous fragments of shells and turtles, bones and teeth of *Hipparion*, &c. As we approach the Niobrara we find that not only the valley of the river but the whole country is covered with the Pliocene formation; and when the different strata are eroded, either in the channel of the streams or on the hills, bones and teeth of extinct mammalia and turtles are found. A section of the Pliocene beds from a vertical cut in the channel of one of the tributaries of the Niobrara presented the following series of strata:

1. Dark gray or brown, loose, incoherent sand, contains remains of *Mastodon* and *Elephant*.
2. A bed of sand gravel with pebbles.
3. A yellowish white calcareous grit with many concretions.
4. Gray grit with a greenish tinge. In this stratum most of the fossils are found.
5. Deep yellowish red arenaceous marl.
6. Yellowish gray calcareous grit with many concretions in layers two to six inches in thickness. Aggregate thickness 60 to 100 feet.

October 14th. Descended the Niobrara twenty-five miles. Sandhills cover the surface of the country a little distance from the river, and high vertical bluffs of Pliocene strata are revealed along the river. The banks of the river as well as those of its tributaries are very steep and high, and close together, forming deep cañons. Where the river has cut through the Pliocene bed numerous fossils were obtained. Upper Miocene bed D of the vertical section is not unfrequently revealed in the channel of the Niobrara, presenting a very irregular outline, showing most conclusively the great erosion that must have taken place prior to the deposition of the Pliocene beds. The irregularity in the surface of the Miocene bed D will be more clearly understood by the illustrated section.

About thirty miles above the mouth of Turtle river, the Cretaceous bed No. 4 is revealed in the channel of the Niobrara, and at the mouth of Turtle river it covers the country with the exception of here and there an isolated hill composed of Pliocene beds. Turtle hill, Medicine and Bijoux hills on the Missouri are outliers of this great recent formation. About forty miles above the mouth of the Niobrara, No. 3 Cretaceous rises above the water-level, and on the Missouri becomes 60 to 80 feet in thickness. The country along the Niobrara is for the most part exceedingly sterile. The surface is principally covered with the movable sandhills, which render travelling very difficult, and very little timber is seen except a few stunted pines along the banks of the little streams. The valley of the Niobrara from its mouth for a distance of 30 or 40 miles, has a tolerably fertile soil with some excellent timber; but above that point to its source near Fort Laramie, the country, though not destitute of vegetation, cannot, it seems to me, be considered otherwise than an uninhabitable desert, fit only for the wild animals of the prairie and the still wilder Indian.

PART II.

The rocks of Nebraska and Kansas, so far as they are known at the present time, are referrible to the following geological epochs:

I. Granite, Stratified Azoic, and Eruptive Rocks.
II. Lower Silurian (Potsdam Sandstone).
III. Carboniferous.
IV. Permian.
V. Jurassic.
VI. Cretaceous.
VII. Tertiary.
VIII. Post Pliocene or Quaternary.

CHAPTER VII.

I. Granite, Stratified, Azoic, and Eruptive Rocks.

In ascending the Missouri river, we meet with no indications of those disturbing influences which have wrought such changes in the physical features of the country in the

vicinity of the mountain chains, until we reach a point near the mouth of Little Rocky Mountain creek, not far above longitude 108°. We then find that the more recent fossiliferous rocks are thrown up and tilted at every angle, and not far distant on either hand we can see the more immediate causes of this disturbance. On our left, about fifteen miles from the Missouri, the Square buttes rise up out of the midst of the prairie like gigantic castles, composed of basaltic and other trappean rocks. These buttes are from 500 to 700 feet in height and cover an area of about three miles in circumference, apparently isolated from the other upheavals in the vicinity. About sixty miles to the west may be seen the Judith mountains, a much larger and loftier range, which seem to be of a geological structure similar to that of the Black hills and Laramie mountains. Far in the dim distance, just on the verge of the horizon, and white as if covered with perpetual snow, are the Girdle and Snowy mountains, quite formidable outliers of the great Rocky Mountain range. On our right, about thirty miles from the Missouri river, we observe the Bear's Paw and Little Rocky mountains, small isolated ranges, from thirty to fifty miles in circumference, the highest peaks of which are from 1500 to 2000 feet above the surrounding prairie. All these isolated upheavals or outliers seem to represent the dying out of that intense subterranean power which elevated the vast central chain.

If we return and ascend the Shyenne river, the first indication of upheaval which comes to our notice is Bear's peak, near longitude 103½°, rising cone-like to the height of 1500 feet above the surrounding country. This peak is also composed of trachytic and basaltic rocks, and seems to have exposed around its base the fossiliferous beds no lower down than the Jurassic or the upper portion of the Permian. We can thus form some idea of the vast area in the northwest, occupied by rocks with strata holding a nearly horizontal position.

If we pass up the valley of the Platte river from its mouth, near lat. 41°, long. 96°, we find the strata undisturbed until we reach Fort Laramie in lat. 42¼°, long. 104½°. About five miles north of the Fort we see the eastern end of a series of ridges formed of numerous conical peaks from 100 to 700 feet in height, the central nucleus composed of a coarse flesh-colored feldspathic granite, surrounded by a series of beds of stratified azoic rocks tilted at all angles. The lowest ridges or more gentle upheavals are usually capped with beds of Carboniferous limestone, which incline at various angles from 5° to 30°. The Tertiary formations in this region belong to the later Miocene period, and, as far as I could ascertain, have not been disturbed in this immediate portion of the country. West of Fort Laramie, on the south side of the Platte, sixty miles distant, we can see Laramie peak, the highest elevation in this region.

This immense mass of rock, which is about 7000 feet in height above the surrounding country, is composed principally of granite, while around its base and sides, as if thrown

off from the granitic nucleus by the upheaval, is a series of azoic stratified rocks, with here and there dikes of trap or basalt. These stratified beds consist of gneiss, hornblende,

Fig. 9.

micaceous and talcose slates, syenite and white quartz, with other varieties of igneous rocks. North of Laramie peak, the Platte river cuts through a large thickness of strata, the lower portion of which is composed of metamorphic rocks, the middle a quartzose limestone resting unconformably upon the rocks below, and the upper 200 feet or more formed of beds of limestone charged with Carboniferous fossils; but along the eastern and southeastern base of the Laramie range the recent Tertiary beds and drift jut up against the foot of the mountains, concealing all the fossiliferous rocks. On the south side of the Platte I observed the Carboniferous beds in but two localities, Warm spring and Cottonwood creek, where they are exposed at each locality over an area of not more than five or six hundred yards square. Proceeding northward from Fort Laramie we meet with frequent elevations revealing a nucleus of igneous rocks, while on the sides and summits are beds of Carboniferous limestone. The highest peak in this direction, forming the eastern limit of the Laramie group, is Rawhide peak, which is 800 feet high, and has a similar geological and mineralogical structure to Laramie peak and Black hills. No Carboniferous rocks were seen immediately in contact with Rawhide peak. Continuing our course toward the Black hills the indication of the internal forces which elevated the Laramie range seem to die out, only comparatively feeble traces remaining to show that the uplift of the two mountain groups were connected and synchronous. After leaving the Niobrara no rocks older than the Cretaceous formation No. 1 are seen until we reach the Black hills.

a group of elevations with a granite nucleus also and surrounded by a series of azoic strata occasionally penetrated by dikes or outbursts of trappean rocks.

"The Black hills, or more properly mountains, lying between the forks of the Shyenne on the 44th parallel, between the 103d and 105th meridians, cover an area of 6000 square miles. Their bases are elevated from 2500 feet to 3500 feet, and the highest peaks are about 6700 feet above the ocean level."* Juya-Kara peak is formed of vertical columns of basalt surrounded with trachytic rocks, which seem to have been thrown off from the summit when the columnar mass was protruded. Near Bear peak on the northeastern side of the Black hills is another example of the protrusion of these basaltic columns, which are five-sided, the sides varying from eight to twenty inches in width. At this locality some of the columns lie in nearly a horizontal position, the greater portion, however, inclining at an angle of 20° to 40°.

From our examinations we thus find that the important outliers on the eastern slope of the Rocky mountains are formed of a granite nucleus surrounded by a series of azoic strata, composed of argillaceous and talcose slates, gneiss, syenite, quartzose, and calcareous rocks. From these facts and from published reports of numerous explorers we think we are warranted in the conclusion that the great central Rocky mountain range possesses a similar geological and mineralogical character. The investigations of Sir John Richardson and Mr. Isbister indicate a striking similarity in the rocks all along the eastern slope from the Saskachewan to the Arctic sea, and the results of the other explorers show a like resemblance far south to Mexico.

The azoic strata which I have described as resting upon granite on the eastern slope of the Rocky mountains appear to be similar in lithological characters and to hold the same geological position as the azoic rocks so largely developed around Lake Superior and in Canada.

CHAPTER VIII.

II. Potsdam Sandstone (Lower Silurian).

The evidence of the existence of this formation in the vicinity of the Rocky mountains was ascertained for the first time in the summer of 1857, during Lieut. Warren's exploration of the Black hills, and first published in a paper read before the Academy of Natu-

* Preliminary Report of Explorations in Nebraska and Dacota, in the years 1855, '6, and '7. By Lieutenant Warren, Topographical Engineer. Page 67.

ral Sciences, in March, 1858. Its largest development and only fossiliferous condition is found in the Black hills, where, by upheaval, it is exposed in the form of a narrow belt or zone engirdling the azoic and granitic rocks, which form the central nucleus of the elevation. I observed no positive indications of this formation in the Laramie mountains or at Rawhide peak, but in most places the Carboniferous strata rested unconformably upon the metamorphic rocks, except in a few localities where a quartzose limestone which is of doubtful age is interposed. From lithological characters and position, I infer that a series of beds resting upon metamorphic rocks at the head of Niobrara river, are of the age of the Potsdam sandstone. Proceeding northward from Fort Laramie, we do not meet again with this formation until we reach the southeastern side of the axis of elevation, when we find it resting unconformably upon gneiss, hornblende, argillaceous and talcose slates, &c., and composed of a variegated gray and reddish-gray quartzose sandstone, filled with small plates of mica. Some parts of it are very compact and silicious, others a coarse friable grit containing seams almost wholly composed of broken fragments of shells cemented with a fine calcareous grit. The more compact masses contain fossils which are quite well preserved, among which can be recognized species of *Lingula*, *Obolus*, and *Trilobites*, similar to or identical with those found in the Potsdam sandstone in other well-known localities. The existence of this formation in some of the important outliers of the Rocky mountains being established beyond a doubt its geographical distribution in the far West then becomes a question of the highest interest. We are now prepared to believe that it is exposed by upheaval all along the eastern slope of the mountains to a greater or less extent, and probably coextensive with the Carboniferous, Permian, Jurassic, and Cretaceous rocks. I will here cite some examples from published reports of beds of sandstone which correspond both in their lithological characters and position to the Potsdam sandstone of the Black hills. Hall, in Stansbury's Report, says that Stansbury's island (Great Salt lake) is three thousand feet high, capped with Carboniferous limestone, which also rests upon a coarse sandstone and conglomerate. Again, north of Great Salt Lake city the limestone overlies a coarse sandstone and conglomerate, which almost invariably accompanies it. In several localities, as at Promontory point and near Mud island, the metamorphic strata appear to be overlaid by a coarse conglomerate or coarse sandstone, which is partially altered and assumes the character of a quartz rock. Marcou, in the third volume of Pacific Railroad Reports, page 156, speaks of a sandstone occurring in the Aztec mountains. He says: "We travelled seven miles upon the granite, and on our right we found a cliff twelve hundred feet in height. From the base to the middle we found the granite, then a band of red sandstone (Devonian or Old Red). Above this the beds of limestone and gray sandstone belonging to the mountain limestone. The following day we travelled three miles on the granite, the remainder on the Old Red sandstone.

The diagram showing the order of the superposition of the different rocks would apply equally well to the similar beds in the Black hills." Many other less evident indications of its existence along the base of the Rocky mountains might be cited from published reports, but what has been said will be sufficient to show, what we may hereafter expect with regard to its geographical distribution in the far West.

Hitherto no indications of the existence of any other member of the Silurian period has been discovered along the eastern slope of the Rocky mountains within the territory of the United States.

CHAPTER IX.

III. and IV. Carboniferous and Permian Periods.

In a former paper I gave to the Permian rocks of Kansas the position of a distinct system in the Kansas and Nebraska series. Subsequent examinations have rendered it somewhat questionable whether they are entitled to the rank of an independent system as developed in Kansas, but rather should be considered as a continuation upward of the Carboniferous period. For this reason I have concluded to treat both subjects under one head. In the first place I will give a brief history of the discovery of rocks in the West containing fossils belonging to Permian types and supposed to be on a parallel with the Permian beds of Europe. The discoveries of Mr. Hawn in Northeastern Kansas were announced in February, 1858, in a paper read before the Academy of Sciences at St. Louis, in which a number of new species of fossils were described and others considered as identical with forms characterizing the Permian rocks of Europe. March 2d of the same year a paper entitled, "Descriptions of new organic remains from Northeastern Kansas, indicating the existence of Permian rocks in that Territory," was read before the Albany Institute, by F. B. Meek and the writer, in which were described ten new species of fossils, most of which seemed to belong to true Permian types. At a meeting of the Academy of Sciences at St. Louis, March 8th, Dr. Shumard stated that he had been studying a group of fossils from a white limestone in the Guadalupe mountains of New Mexico, and arrived at the conclusion that they are of Permian age. He says that several of the species are identical with Permian forms from England and Russia, also with species obtained from the Permian rocks in Kansas. In a letter to the Academy of Sciences at St. Louis, dated March 31st, Dr. Norwood announced the discovery of Permian fossils in Illinois; and at the meeting of the American Association for the Advancement of Science at Baltimore, in April, Mr. A. H. Worthen, State Geologist of Illinois, read a paper on the Permian rocks

of that State, and exhibited a fine collection of fossils which he considered as belonging to that system. Prof. Hall, in his Iowa Report, thinks there is some evidence of the occurrence of the same series of rocks in Western Iowa, so that we already have indications of the existence of the supposed Permian system in Kansas, Nebraska, New Mexico, Illinois, and Iowa, and future investigations may reveal it in Missouri and other Western States.

During the past summer Mr. F. B. Meek and the writer made a geological exploration of that portion of Kansas bordering upon the Kansas river and its tributaries, for the purpose of attempting to solve the interesting problem of the relations of the Carboniferous rocks to the supposed Permian strata of that Territory. We found that all the eastern portion of that Territory from the Missouri river to longitude 98° was occupied by Carboniferous and Permian rocks, with outliers and overlapping edges of the Cretaceous Red Sandstone No. 1 of our Nebraska section. The results of our labors were embodied in a paper* read before the Academy of Natural Sciences at Philadelphia, January, 1859, from which I extract the following pages:

The route pursued by us while making these investigations, was first from Leavenworth city on the Missouri, across the country to Indianola, near the mouth of Soldier creek, on the Kansas; thence up the north side of Kansas and Smoky Hill rivers, to the mouth of Solomon's fork. Here we crossed the Smoky Hill, and followed it up on the south side to a point near the ninety-eighth degree of west longitude; from which point we struck across the country in a southeast direction to the Santa Fe road, which we followed northeastward to the head of Cottonwood creek. Leaving the road here, we went down the Cottonwood valley some thirty miles, when we turned across the country nearly due northward to Council Grove. From the latter place we followed the Santa Fe road back southwestward about twenty-four miles to a watering-place known as "Lost Spring;" here we again left the road and struck across the country in a northwest direction to Smoky Hill river, at a point nearly opposite the mouth of Solomon's fork. We then travelled down the south side of Smoky Hill and Kansas rivers to Lawrence, where we crossed the Kansas and proceeded in a northeast direction back to Leavenworth city.

The first outcrop of rocks examined by us during the expedition is at a point just below the steamboat landing at Leavenworth city. At this place and for some distance above on the river, the formation is well known to belong to the upper, but not the highest portions, of the great western coal measures.

The section here near the Leavenworth landing, presents the following beds, in descending order:

* Geological Explorations in Kansas Territory. Proc. Acad. Nat. Sci. Pa., January, 1859.

	Feet.
1. Bluish gray clay, exposing a thickness of about	3
2. Hard gray layer of *Fusulina* limestone,	1¼
3. Yellow laminated clay,	7
4. Hard gray argillaceous limestone with *Fusulina*,	1
5. Gray fine-grained argillaceous sandstone with fucoidal markings, sometimes contains seams of limestone,	1 to 3
6. Gray, green, and blue, rather indurated clay, with sometimes near the base many compact concretions of limestone,	2
7. Hard light yellowish gray limestone, usually of bluish tinge far in beyond the effects of weathering. Contains *Spirifer cameratus, S. Kentuckensis, S. lineatus, Spirigera subtilita, Orthisina Missouriensis, Productus splendens? ; P. semireticulatus? ; P. pustulosus* and *Fusulina cylindrica*, together with columns of *Crinoids*, and spines and plates of *Archæocidaris ;* also jaws and teeth of *Xystracanthus arcuatus*,	15
8. Dark shale, passing up into gray less distinctly laminated clay,	5
9. Hard dark bluish impure limestone, containing *Fusulina cylindrica, Spirigera subtilita, Productus Rogersi, P. Prattenianus, Arca carbonaria ? ;* an undetermined *Monotis, Allorisma ? Leavenworthensis, A. subcuneata, Myalina subquadrata, Leptodomus granosus*, and a large *Bellerophon*,	1½–2
10. Gray, more or less laminated clay, becoming darker near the upper part, rising above the river,	11

Attached to the surfaces of bed No. 9 there is usually from one to two inches of soft dark argillo-calcareous matter containing great numbers of *Orthisina crassa*, with the undetermined species of *Pecten, Mytilus, Schizodus, Pleurotomaria*, &c.

All this section above No. 7 appears to vary considerably, at different places some of the beds being entirely wanting, or presenting quite different lithological characters at other localities not far from here. Owing to the dip of the strata and partly to the fall of the river, the bed of limestone No. 7, which is elevated eighteen feet above the river where this section was taken, rises as much as twenty-five feet above the level of the river at a distance of one mile or less below ; and on following the outcrop of these rocks along the shore above Leavenworth city, they were found to sink gradually beneath the water, so that at Fort Leavenworth landing, two miles above (in a north direction from the exposure first examined), all of beds Nos. 8, 9, and 10, as well as two or three feet of No. 7, were submerged. Should this dip continue at the same rate, without local undulations, the whole of No. 7 must pass beneath the river in less than two miles above the Fort.

Immediately above No. 1 of this section, we saw no exposure of rock in place, but on a small stream about two and a half miles below Leavenworth city, and perhaps one and a half miles back from the river, there is an outcrop of soft fine-grained yellow sandstone, showing a thickness of twenty-four feet, underlaid by a bed of blue clay, of which a thickness of about four feet was exposed. We had no opportunity to determine the elevation of these beds above the river with sufficient accuracy to form a definite conclusion whether or not they hold a position above the section seen near the Leavenworth landing, though we incline to the opinion that they come in above it.

In ascending the hills back of Leavenworth city we observed no outcrops of rock along the slopes until near the summit, where at an (estimated) elevation of about two hundred feet above the highest bed of the section at the river, there is an exposure of hard bluish gray impure limestone, weathering to a yellowish tinge, the beds of which are separated at places by partings of clay. Of this rock we saw a thickness of sixteen feet. It is much used for building purposes, and quarried rather extensively back of Fort Leavenworth. At one of these quarries, amongst the loose material thrown out by the workmen, we found specimens of *Spirifer cameratus*, *S. Kentuckensis*, *S. planoconvexa*, *S. hemiplicata*, *Spirigera subtilita*, *Productus semireticulatus*, *P. Norwoodii*, *Leptodomus Topekaensis*, *Fusulina cylindrica*, *Terebratula millepunctata*, and fragments of *Crinoids*, with *Chætetes* and *Fenestella* of undetermined species.

Above the quarry there is a slope of some forty or more feet to the summit of the hills, apparently occupied by clays; and the quarrymen informed us that there is immediately under the bed of limestone an eight feet bed of clay, beneath which they had made no excavations.

West of this locality the surface of the country soon descends gradually into a depression connected on the north with the valley of a small stream flowing into the Missouri above Fort Leavenworth. In this immediate neighborhood the face of the country is slightly inclined to be hilly, but the soil is rich, and the long gentle slopes are clothed in the spring and summer months with a luxuriant growth of prairie grass. From several points near here we had a fine view of the broad rich valley, with its beautiful groves and scattering farmhouses along the little stream to the north of us.

Beyond this the road, after passing over some undulations, ascends to the summit of the country, which is rich elevated prairie land. At several places near the upper part of the slopes, some five or six miles from Leavenworth, we met with outcrops of light gray limestone, apparently in ten to twelve inch layers, containing *Fusulina*, *Productus semireticulatus*, *Chætetes*, and small *Cyathophylloid* corals. These beds probably belong to the same horizon as the limestone near the top of the bluffs back of Leavenworth, or may even hold a higher position.

At Big Stranger creek, some fourteen or fifteen miles west of Leavenworth city, the following section was observed in descending order:

	Feet.
1. Slope, without any exposure of rocks,	60
2. Layers of limestone, weathering yellowish, containing *Spirifer cameratus* and *Fusulina cylindrica*,	8
3. Slope, probably occupied by shale or clay,	40
4. Grayish yellow limestone, with *Fusulina cylindrica* and *Spirigera subtilita*,	5
5. Bluish gray soft shale, or laminated clay with occasional harder sandy seams,	38
6. Coal immediately overlaid by one inch of *cone-in-cone*,	½
7. Bluish gray laminated clay or soft shale, extending down to the creek,	18

Again, on Little Stranger creek, some twelve miles southwest of Leavenworth city, there is a somewhat similar exposure, containing a twenty inch bed of coal. This bed is worked to some extent on the land of Mr. Charles Stone, where the following section may be seen in the descending order:

	Feet.
1. Light gray, or bluish gray, soft calcareous sandstone, with harder layers containing much argillaceous matter, with *Productus splendens?*, *Myalina subquadrata*, an undetermined *Monotis*, and many fucoidal markings, exposing a thickness of	15
2. Blue laminated clays more or less arenaceous above,	26
3. Coal,	1¾
4. Bluish gray somewhat ferruginous clay rising above the creek,	4

We have no means of determining what relations the rocks composing these two sections bear to the exposure at Leavenworth, but we think they hold a position between the bed of limestone seen near the top of the hills back of Leavenworth city, and the upper bed of the section near the Leavenworth landing.

Between Big Stranger and Grasshopper creeks, the road passes over a beautiful rich prairie, elevated about 350 or 400 feet above the Missouri. In crossing this prairie we met with no exposures of rock, the whole being covered by heavy Quaternary deposits, into which wells have been sunk at several places, from thirty to seventy feet, without striking solid rock *in situ*. At one or two places, however, we saw masses of limestone which had been quarried for building purposes along a little stream two or three miles north of the road. These contained amongst other fossils *Spirifer cameratus*, *Orthisina umbraculum?*, *Fusulina cylindrica*, and fragments of *Fenestella*, with spines and plates of *Archæocidaris*. We had no opportunity to examine the quarry from which this rock was obtained, but were informed that the bed is some sixty or seventy feet below the summit of the higher portions of the surrounding country.

In descending from this elevated prairie into the valley of Grasshopper creek, at Osawkee village, we observed,—

	Feet.
1. A bed of hard gray limestone near the summit of the slopes, containing great numbers of *Fusulina*,	8
2. Slope, no rocks exposed, about	55
3. Outcrop of *Fusulina* limestone, apparently	3
4. Slope, no rocks exposed,	50
5. Gray or bluish gray limestone, weathering yellowish, containing *Pleurotomaria humerosa*, *P. subturbinata*, and a large undetermined species of *Bellerophon;* also *Allorisma? Leavenworthensis*, *Myalina subquadrata*, *Pinna* undt., *Spirifer cameratus*, *S. planoconvexa*, and *Productus æquicostatus*, with great numbers of *Fusulina cylindrica*,	3
6. Dark gray indurated clay,	2
7. Rather soft argillaceous limestone,	4

The fact that several of the fossils seen here in bed No. 4 are the same species found in No. 5 of the section at Leavenworth landing, would seem to indicate that these beds occupy the same geological horizon. It is very difficult, however, to identify the same beds at different localities amongst these formations in consequence of the fact that the fossils found in them usually have a great vertical range, and exactly similar strata are often repeated in various parts of the series. Should it prove to be the case that they do occupy the same geological horizon, it would show that there is here a gentle eastward dip; for the lowest bed of this section on Grasshopper creek cannot be less than 100 feet higher than the base of the section at Leavenworth city.

Still we incline to the opinion that the strata near here, if not almost horizontal or merely undulating, have a general inclination towards the west, or somewhat north of west, and that the exposure on Grasshopper creek is composed of much more modern beds than those near the landing at Leavenworth city. At any rate we saw an exposure at Lawrence landing, on the Kansas, composed of ledges of limestone, overlaid by clay, and having a decided dip to the west or north of west, at a rate of not less than fifty feet to the mile. This limestone consists of an upper hard gray layer, about three feet in thickness, resting on a soft gray arenaceous bed, of which some one or two feet were visible above the surface of the river when examined by us. In these beds we saw *Spirigera subtilita*, *Productus splendens?*, and *Myalina subquadrata*. Above these, about eleven feet of gray laminated clay were exposed, the upper part of the bed having a more yellowish tinge, and containing more arenaceous matter than the lower.

If these beds continue to rise at the same rate towards the east, they must of course run out on the summit of the highest part of the country not far east of Lawrence; and the same inclination to the west or northwest would take them far beneath the horizon of the base of the section seen on Grasshopper creek.

Above this exposure at Lawrence landing, there is a space of about 160 feet in which no outcrops were seen excepting some red and blue clays near the upper part of the hills, back of the town. Just above these clays, some ledges of gray limestone were seen, apparently altogether about eight feet in thickness, containing *Fusulina cylindrica*, *Spirigera subtilita*, and *Spirifer cameratus*.

West of Grasshopper creek, on both sides of the Kansas, the country becomes lower near the river, but at a distance of some ten or twelve miles back, on the north side, it appears to be nearly as elevated as on the east of Grasshopper creek. Between this higher country and the Kansas there is a plateau, apparently elevated not more than sixty feet above the broad level prairie bottoms along the river; while on the south of the Kansas, some five or six miles southwest of Topeka, there are some isolated hills, apparently of the same elevation as the high country north of the Kansas.

At several places soon after crossing Grasshopper creek, we met with some highly fossiliferous beds along the small streams, at an elevation of apparently about eighty feet above the Kansas. Below we give a section of these beds seen at a locality some eight miles southwest of the point where the exposures mentioned on Grasshopper creek were observed:

	Feet.
1. Rough seams and layers of concretionary limestone of bluish tinge with partings of clay, containing *Terebratula millepunctata, Spirigera subtilita, Spirifer cameratus, S. Kentuckensis, Retzia Mormonii, Rhynchonella Uta, Productus Norwoodii, P. splendens?, P. semireticulatus, P. Prattenianus, Orthisina*, similar to *O. umbraculum*, also *Fenestella*, and *Chætetes*, of undetermined species,	4
2. Black shale, shading upwards gradually into laminated blue clay,	2½
3. Hard blue or gray limestone, with *Spirifer cameratus, Spirigera subtilita, Myalina, Pecten*, &c.,	1
4. Bluish gray soft clay, with seams of hard limestone,	3
5. Light gray, somewhat granular limestone, with a few round grains, and very small pebbles of quartz,	2

At another place on the south side of the Kansas, about twelve miles southwest of the point where the last section was seen, there is an abrupt bluff near the old Baptist Mission, composed of the following beds in the descending order:

	Feet.
1. Slope, no rocks exposed,	20
2. Hard yellowish gray limestone, with fragments of fossils,	4
3. Slope, no rock exposed,	18
4. Light gray, rather hard, fine-grained sandstone,	3
5. Slope,	20
6. Fine-grained sandstone, in thin layers, not well exposed; apparently	2
7. Slope, with occasional outcrops of hard gray limestone,	16
8. Yellowish and dark gray laminated clay, or soft shale, with layers and nodular concretions of argillaceous carbonate of iron, near base,*	90
9. Hard bluish argillaceous limestone, of which there was exposed in the bed of a small stream, not more than 13 or 15 feet above the river, a thickness of	1

After passing this locality, we heard of a coal mine some three or four miles south of here, near the base of an isolated hill, known as Shunganunga mound. We did not visit this mine, but were informed that it is considerably above the summit of the last section, and that the bed is about eighteen inches in thickness. The coal is said to be of good quality.

Above here, on both sides of the Kansas, the country continues to be rather low, no part of it being, apparently, more than two hundred feet above the river. For a long distance above this there is a beautiful broad level bottom prairie, on the north side of the

* There may be some thin beds of limestone in this portion of the section, as every part of this ninety foot bed was not well exposed.

Kansas, extending back from four to six miles, and as much as eighteen or twenty miles along the river. Bounding this on the north the country rises by a gentle grassy slope to an elevation of from sixty to about one hundred feet, furnishing the most beautiful sites for dwelling-houses.

For a considerable distance above the locality where the exposure near the old Baptist Mission was examined, the hills, especially near the river on the south side, appear to be mainly composed of rather heavy deposits of laminated clays and shales, with soft sandstones and occasional thin beds of limestone, containing the usual fossils of the Upper Carboniferous series. At the crossing of Mission creek, at an elevation of perhaps not more than twenty-five or thirty feet above the Kansas, exposures were observed consisting first above of five feet of light gray laminated clay, resting upon two or three feet of soft yellow sandstone, which passes down into laminated arenaceous clays, of which some eight or ten feet were exposed above the creek.

Some fifteen or sixteen miles west of the point where the road crosses Mission creek, at a locality six or seven miles south of the Kansas, there is a high elevation, known by the name of Buffalo mound, rising as much as four hundred and fifty or sixty feet above the river. At one place a large creek, called on the maps Upper Mill creek, sweeps close along the northern base of this elevation, and has carried away the loose debris so as to leave the lower strata well exposed The section here beginning at the summit of this hill is,—

	Feet.
1. A slope of about 160 feet, along the lower forty feet of which we found loose specimens of *Spirifer cameratus, S. planoconvexa, Retzia Mormonii, Productus splendens?, Chenetes Verneuiliana, C. mucronata,* and *Fusulina cylindrica,* var. *ventricosa,* with fragments of *Chætetes, Crinoids,* &c., of undetermined species, ...	
2. Bluish gray limestone in two layers, the upper of which contains columns of *Crinoids, Productus Calhounianus,* &c., while *Myalina subquadrata, Orthisina Missouriensis, Allorisma, Pinna, Monotis,* &c., of undetermined species, occur in the lower, ...	3
3. Slope, with no exposures of rock, ...	96
4. Rather hard mottled brown and light gray compact limestone, with a few *Crinoid* columns; may be thicker, but only showing a thickness of	3
5. Brown, whitish, and green clays, with rugged white calcareous concretions, ...	4
6. Fine argillaceous sandstone, with streaks of yellow and brown colors, ...	1½
7. Ash-colored clay, ...	10
8. Clays of red or brownish colors above; blue and green below, ...	3½
9. Deep brown clay, with rugged concretions of same color, ...	3
10. Hard light bluish limestone, with some rather large columns of *Crinoids, Chonetes, Verneuiliana,* &c., .	2½
11. Brown, ash-colored, and blue laminated clays, which are more or less arenaceous, with near the middle some 5 or 6 inches black shale, ...	46
12. Gray and purple argillaceous limestone, with *Pinna, Productus,* and a few *Fusulina,*	1½
13. Green laminated clay, ...	4

	Feet.
14. Two or three layers of soft fine-grained sandstone, more or less argillaceous, and separated by seams of clay,	2
15. Bluish and ash-colored clays,	21
16. Alternate layers of hard bluish gray limestone, and seams of clay with sandy concretions,	3
17. Rather hard yellowish limestone, with *Fusulina*,	2½
18. Ash-colored clay, not very well exposed,	15
19. Yellowish impure limestone, with *Fusulina*,	2
20. Ash-colored laminated clays—above the creek,	5

About three hundred yards below where this section was taken, the creek was observed to fall nearly a foot, over a ledge of hard limestone; and one mile further down, the bed of the creek is composed of a hard yellow limestone, containing great numbers of *Fusulina*. At these localities Mill creek is probably not elevated more than thirty feet above the Kansas.

Near half a mile east or southeast of the point where the *Fusulina* limestone was seen in the bed of Mill creek, and at a somewhat higher elevation, we saw apparently the same bed of *Fusulina* limestone, showing a thickness of three feet. Under this there was at one place exposed a thickness of some four or five feet of very fine yellow sandstone with minute specks of mica. These exposures indicate a moderate dip of the strata towards the west or northwest.

On the north side of the Kansas, in a direction a little west of north, and about sixteen miles from the last-mentioned localities, we observed an outcrop, on a small stream marked "Last creek" on the maps, presenting the following section, descending:

	Feet.
1. Seams of yellow magnesian limestone, alternating with clay, showing a thickness of about,	8
2. Yellow soft granular magnesian limestone, containing *Productus Norwoodi*, and an undetermined species of *Myalina*,	4
3. Fine laminated black shale,	1
4. Gray rather soft argillaceous limestone,	1
5. Blue somewhat indurated very fine calcareous clay, containing at its junction with the next bed below *Chonetes, Synocladia biserialis, Chætetes*, and fragments of *Crinoids*,	9
6. Seams of hard compact gray limestone, alternating with softer argillo-calcareous matter, and containing casts of many small *Cypricardia*-like shells, small *Murchisonia, Pleurotomaria, Macrocheilus, Naticopsis, Bellerophon*, &c.,	2
7. Bluish laminated clays weathering to drab color,	4
8. Yellow rather soft granular magnesian limestone, with embedded fragments of harder more compact do.,	5½
9. Bluish indurated calcareous clays,	3

The base of this section is evidently not elevated much above the Kansas, as it extends down to the bottom of a deep ravine formed by the creek, while its top appeared to be

nearly on a level with the surface of the bottom prairie in the Kansas valley. These beds dip a little to the northwest, and are very similar, especially the magnesian limestones, to some of the Permian strata holding a position far above this in the series, some considerable distance west of here. Only about three miles further west we saw the following exposure on Vermilion creek:

	Feet.
1. Slope of about fifteen feet, with near the base some ledges of gray limestone, amongst loose fragments of which we picked up specimens of *Spirigera subtilita*, *Spirifer hemiplicata*, *Productus Norwoodii*, and *P. splendens?*	15
2. Slope, no rock seen,	26
3. Soft bluish and gray more or less laminated clays, with irregular sandy seams and concretions,	12
4. Irregular hard blue calcareous seam one to six inches,	½
5. Blue clay,	2
6. Soft decomposing more or less laminated sandstone,	4
7. Blue clay one foot above the creek,	1

Almost directly opposite these localities, on the south side of the Kansas, some three or four miles back from the river, and nearly on a line between the locality where we saw the exposures on "Last creek" and Buffalo mound, but considerably below the level of the summit of the latter, we examined some exposures presenting beneath a slope of about eighty feet, in descending order:

	Feet.
1. Hard bluish gray limestone, of which there was exposed	1
2. Rough yellowish magnesian limestone with cavities lined with chalcedony,	3
3. Bluish and ash-colored clays,	5
4. Layer much like No. 2,	1
5. Yellowish green clay,	20
6. Bluish gray limestone in two layers, the upper of which contains columns of *Crinoids*, *Productus Calhounianus*, &c., while *Myalina subquadrata*, *Orthisina Missouriensis*, *Allorisma*, *Pinna*, *Monotis*, &c., occur in the lower,	3
7. Bluish and ash-colored clays, exposing a thickness of	5

The bed No. 6 of this section is evidently the same as No. 2 of the section at Buffalo mound (page 12), though here the dip of the strata has brought it lower. Its elevation above the Kansas at Buffalo mound must be about two hundred and fifty feet. We had no means of estimating very accurately its elevation where the last section was taken, though we do not think it as much as one hundred and seventy-five feet above the Kansas.

Ten miles farther west, on the same side of the river, along a small stream marked "Deep creek" on the maps, at a point some four or five miles back from the Kansas, and elevated perhaps as much as forty feet above it, some outcrops were examined near Zeandale, presenting the following section, descending:

	Feet.
1. Long slope of about one hundred feet, no rocks seen,	100
2. Dark argillaceous limestone, stained with iron, and containing fragments of *Crinoids*,	4
3. Soft decomposing argillaceous limestone,	2
4. Very hard light yellow compact limestone in one massive bed, containing great numbers of *Fusulina*, also *Productus Calhounianus*, &c.,	6
5. Ash-colored laminated clay,	22
6. Hard decomposing argillaceous limestone with *Fusulina*,	3
7. Blue, green, and ash-colored clay,	18
8. Gray argillaceous limestone, with more or less ferruginous matter,	3
9. Light bluish clay somewhat laminated,	7
10. White decomposing argillaceous limestone with *Productus Calhounianus*,	1

We heard of a bed of coal some four or five miles above this on the same creek, but were unsuccessful in an attempt to find the locality where it crops out. We were informed, however, by Mr. Pillsbury, an intelligent gentleman living at Zeandale, that the bed is from four to six inches in thickness, and overlaid by about three and a half feet of blue shale, strongly impregnated with alum. Above the latter he said there is an eight or ten inch layer of dark argillaceous material, weathering to an iron rust color, and containing many nodular concretions,—perhaps of carbonate of iron. From the information obtained in regard to the location and elevation of this coal bed, we are inclined to believe it must hold a position a little below the horizon of the middle of the slope at the top of the foregoing section. It is probably the highest bed of coal in the whole series of this region,—at any rate we saw no indications of coal above it.

About a mile or a mile and a half north of the locality where this coal bed has been seen, the dividing ridge between the Kansas and Deep creek, rises to an elevation of near three hundred and twenty feet above the latter stream at the nearest point. Here at the summit of this ridge there are some thin outcrops of gray and whitish argillaceous limestone, showing on weathered surfaces a somewhat laminated structure, and containing at places large spines of a species of *Archæocidaris;* beneath this there is about two feet of gray fragmentary limestone reposing on a more compact bed of hard gray limestone near three feet in thickness, and often cellular in the middle. Along the slope, about one hundred and twenty feet below the horizon of these beds, we found loose specimens of *Spirifer cameratus*, *Orthisina umbraculum?*, *Rhynchonella Uta*, *Allorisma*, *Synocladia biserialis*, &c. Just below these, there were many loose slabs of light yellowish fine-grained calcareous sandstone, containing *Productus*, *Pecten*, and *Fucoidal* markings. About forty-seven feet lower down the slope, and near one hundred and fifteen feet above the level of the Kansas, there is an exposure of light grayish yellow granular limestone, showing a thickness of three feet, in which we only saw fragments of a *Chonetes*, and

Crinoid columns: large tabular masses of this rock were strewed along the slope for some distance below.

At the mouth of the Big Blue river, on the south side of the Kansas, there is an abrupt bluff, along which several slides have exposed many of the beds composing the high ridge mentioned six or seven miles below here. The dip, however, of the strata towards the west or northwest is so great that the limestone containing spines of *Archæocidaris*, seen on the summit of the ridge below this, at an elevation of about 320 feet above the Kansas, is here, opposite the mouth of the Big Blue river, only elevated about 214 feet above the Kansas; consequently the three feet of grayish yellow limestone cropping out 115 feet above the Kansas along the slope of the ridge above mentioned, at the mouth of the Blue river, has sunk beneath the level of the Kansas.

This far we have scarcely attempted to draw parallels between the various beds seen by us at different places, in consequence of the fact that our observations were isolated, as must necessarily be the case in a mere reconnoissance, extended over a large area in a short space of time. In addition to this, the group of rocks examined presents no extensive beds of limestone or other hard material, forming well-marked horizons, or continuous lines of outcrop, by which the relations between strata seen at different localities could be traced out. This difficulty is also greatly increased by the frequent repetition of precisely similar beds at different horizons in the series, and above all by the great vertical range of the organic remains. Consequently we have preferred to present separately the local sections examined, instead of attempting to construct a continuous general vertical section showing the order of superposition of the various strata. To do this successfully throughout all the various rocks of the whole Kansas valley would require much more time than we had at our command.

As our examinations along the Kansas and Smoky Hill rivers above this point were made in more detail, where the outcrops were more frequent and continuous, we have, as we believe, been able to trace out the connections and order of succession of the various strata with considerable accuracy. Hence, we give below a general section of the rocks in this region, commencing with the Cretaceous sandstones on the summits of the Smoky hills, lat. 38° 30′ N., long. 98° W., and descending through the various intermediate formations seen along the Smoky Hill and Kansas rivers, to the base of the bluff already mentioned, opposite the mouth of Big Blue river, on the Kansas. It is true, there are a few gaps in this section, where we were unable to see the beds along some of the slopes, but as we know the position in the series, as well as the extent of these gaps, it will be easy to determine, when a greater number of exposures have been examined, the nature of the beds occupying them.

General section of the Rocks of Kansas Valley from the Cretaceous down, so as to include portions of the Upper Coal measures.

Feet.

1. Red, brown, and yellowish, rather coarse-grained sandstone, often obliquely laminated, and containing many ferruginous concretions; also, fossil wood and many leaves of dicotyledonous trees, some of which belong to existing genera, and others to genera peculiar to the Cretaceous epoch. *Locality, summit of Smoky hills,* 60
2. Whitish, very fine-grained argillaceous sandstone, underlaid by bluish purple and ash-colored clays. *Locality same as preceding,* 15
3. Long, gentle slope, with occasional outcrops of ash-colored red, blue, and whitish, more or less laminated clays, with thin beds of sandstone. *Locality same as preceding, and extending down at places nearly or quite to the bluffs of Smoky Hill river;* thickness about 200
4. Red sandstone, with some layers of hard, light gray calcareous, do., and both containing ferruginous concretions. *Locality, bluffs of Smoky Hill river, five or six miles above Grand Saline river.* Probably local, thickness seen about 15
5. Bluish, red, light yellow, and gray clays, and soft claystones, with sometimes a few thin layers of magnesian limestone. In many places these clays have been traversed in every direction by cracks, into which calcareous and argillaceous matter have found their way, and subsequently become consolidated so as to form thin seams of impure yellowish limestone, which cross and intersect each other at every angle. The red clays are usually less distinctly laminated, contain more arenaceous matter, and often show ripple-marks on the surfaces. *Locality, Bluffs along Smoky Hill river, above the mouth of the Grand Saline,* 60
6. Light gray, ash-colored, and red clays, sometimes arenaceous, and often traversed by cracks, filled with calcareous matter as in the bed above,—alternating with thin layers and seams of gypsum. *Locality, near mouth of Smoky Hill river,* 40
7. Rather compact amorphous white gypsum, with near the base disseminated crystals, dark-colored do. *Locality same as last,* . . . . . 4½ to 5
8. Alternations of ash-colored, more or less arenaceous clays, with thin beds and seams of gypsum above; towards lower part, thin layers of claystone, and at some places soft magnesian limestone. *Locality same as last,* 50
9. Rough conglomerated mass, composed of fragments of magnesian limestone and sandstone, with sometimes a few quartz pebbles, cemented by calcareous and arenaceous matter; variable in the thickness and probably local. *Locality, south side of Smoky Hill river, ten or twelve miles below Solomon's fork,* seen 18
10. Bluish, light gray, and red laminated clays, with seams and beds of yellowish magnesian limestone, containing *Monotis Hawni, Myalina perattenuata, Pleurophorus? subcuneata, Edmondia? Calhouni, Pecten* undt., and *Spirigera* near *S. subtilita;* also *Nautilus eccentricus, Bakevellia parva, Leda subscitula, Axinus rotundatus,* and undetermined species of *Bellerophon, Murchisonia,* &c. *Locality, near Smoky Hill river, on high country south of Fort Riley, as well as on Cottonwood creek,* 90
11. Light grayish and yellow magnesian limestone, in layers and beds, sometimes alternating with bluish and other colored clays, and containing *Solemya,* a *Myalina* near *M. squamosa, Pleurophorus? subcuneata, Bakevellia parva, Pecten* undt., and a *Euomphalus* near *E. rugosus;* also, a *Spirigera* allied to *S. subtilita,* but more gibbous, *Orthisina umbraculum?, O. Shumardiana,* &c. *Locality, summit of the hills, near Fort Riley and above there; also seen on Cottonwood creek,* . . . . . 25 to 35

Feet.

12. Light grayish yellow, rather granular magnesian limestone, containing spines and plates of *Archæocidaris;* a few fragments of small *Crinoid* columns, *Spirifer* similar to *S. lineatus*, but perhaps distinct; also same *Spirigera* seen in beds above, *Orthisina Shumardiana, O. umbraculum?* and *Productus Calhounianus. Forms distinct horizon near summit of hills in vicinity of Fort Riley, also seen on Cottonwood creek,* . . . . . 7 to 8
13. Soft argillo-calcareous bed, apparently local. *Kansas falls,* 5
14. Light grayish and yellowish magnesian limestone, containing many concretions of flint, also the same *Spirigera* found in beds above, and *Productus Norwoodi, P. Calhounianus*, with *Discina tenuilineata* and an undetermined *Monotis. Fort Riley and below, also at Kansas falls and on Cottonwood creek,* . 38
15. Alternations, bluish, yellowish and brown clays, with a few thin seams of limestone. *Fort Riley, Kansas falls; also below Fort Riley, and on Cottonwood creek,* 35
16. Light yellowish magnesian limestone, containing *Fucoidal* markings, fragments of small *Crinoid* columns, *Pecten, Allorisma, Spirigera, Orthisina umbraculum?, O. Shumardiana, Discina tenuilineata*, &c. *Lower quarry at Fort Riley, and at other places above and below Fort Riley, as well as on Cottonwood creek,* . . . . . 4 to
17. Alternations of blue, red, and light gray clays, with sometimes thin layers and seams of magnesian limestone. *Fort Riley,* 28
18. Light gray and whitish magnesian limestone, containing *Spirigera, Orthisina umbraculum?, O. Shumardiana, Productus Calhounianus, Acanthocladia Americana*, and undt. *sp. Cyathocrinus.* Lower part containing many concretions of flint. *Fort Riley and on Cottonwood creek.* Whole thickness about 40
19. Brown, green, and very light gray clays, alternating; contains near the upper part fragments of *Crinoid* columns, *Synocladia biserialis, Spirigera, Productus Norwoodi, Chonetes mucronata, Orthisina Shumardiana, Orthisina umbraculum*, &c., with teeth of *Petalodus Alleghaniensis. Fort Riley,* . . 14
20. Alternations of rather thin layers of light yellowish magnesian limestone, and various colored clays; the limestone layers containing *Monotis, Synocladia biserialis*, &c. *Locality same as last,* . . . 33
21. Slope, no rocks seen. *Below Fort Riley,* 25
22. Whitish, or very light gray magnesian limestone, rendered porous by cavities left by the weathering out of numerous *Fusulina.* This is the highest horizon at which any remains of *Fusulina* were met with. *Some four miles below Fort Riley, along a creek on the south side of the Kansas, and apparently not more than ten feet above it,* 2
23. Bluish, light gray, and brown clays, with occasional layers of magnesian limestone. *Chonetes mucronata, Orthisina umbraculum?, Monotis, Fusulina*, &c. *Ten miles below Fort Riley,* . . . 35
24. Hard, very light yellowish gray magnesian limestone, with *Fusulina*, and spines of *Archæocidaris.* Forms a marked horizon near the *same locality as last,* 6
25. Slope, with occasional exposures, thin layers of *Fusulina*, limestone, and seams of gray limestone containing *Myalina, Monotis, Pecten*, and fragments of *Synocladia biserialis. Near same locality as last,* . 36
26. Light gray argillaceous limestone, showing on weathered surfaces a somewhat laminated structure; contains large spines of *Archæocidaris. Near Ogden ferry and Manhattan,* 9
27. Gray limestone, often fragmentary, with much clay above; lower part hard, and more or less cellular in middle. *Locality same as last,* 5
28. Whitish clays and claystones, with a thin layer of hard compact gray limestone near the middle. *Locality same as last,* 10
29. Light greenish indurated clays. *Same locality,* 3

30. Hard, heavy-bedded, white argillaceous limestone, containing *Monotis* and *Avicula*. *Ogden ferry, and below there*, ... 5
31. Very thinly laminated dark green shale. *Three miles nearly east of Ogden ferry, on McDowell's creek; also at Manhattan on the Kansas*, ... 1
32. Light greenish and flesh-colored hard argillaceous limestone, with *Spirifer cameratus*. This is the highest horizon at which we found this species. *Same localities*, ... 3
33. Alternations of bluish, green, and red, more or less calcareous laminated clays, light gray limestones and claystones, with *Pecten, Monotis*, and fragments of *Crinoid* columns. *Same localities*, ... 30
34. Alternations of bluish, purple, and ash-colored calcareous clays, passing at places into claystones, and containing in a thin bed near the middle, *Spirifer planoconvexa, Spirigera subtilita, Productus splendens?, Rhynchonella Uta*, &c. *Locality same as preceding*, ... 12
35. Blue, light gray, and greenish clays, with occasional harder seams and layers of claystone and limestone. *Same locality*, ... 33
36. Somewhat laminated claystone of light gray color, with more or less calc spar near lower part. *Manhattan*, 19
37. Alternations of dark gray and blue soft decomposing argillaceous limestone, with dark laminated clays, or soft shale, containing great quantities of *Fusulina cylindrica, F. cylindrica* var. *ventricosa, Discina Manhattanensis, Chætetes*, and fragments of *Crinoids;* also, *Chonetes, Verneuiliana, C. mucronata, Productus splendens?, Retzia Mormonii, Rhynchonella Uta, Spirigera subtilita, Spirifer cameratus, S planoconvexa, Euomphalus* near *E. rugosus*, and *Synocladia biserialis;* also *Cladodus occidentalis. Locality, same as last*, ... 18
38. Soft bluish shale, with yellow laminated arenaceous seams below, containing Fucoidal markings. *Same locality*, ... 25
39. Two layers gray argillo-calcareous rock, separated by two feet of dark green and ash-colored clays. The calcareous beds contain fragments of Crinoids, Chonetes, and *Myalina* of undetermined species. *Same locality as last*, ... 4½
40. Light greenish, yellow, and gray clays and claystones, extending down nearly to high water mark of the Kansas, *opposite the mouth of Blue river*, ... 27

The foregoing general section of the strata seen along the valley of Kansas and Smoky Hill rivers, from the mouth of Blue river to the 98th degree of west longitude, is presented in its present form more with a view of illustrating the vertical range of the organic remains found in these rocks, than as an attempt to group the beds into formations that may be expected to preserve their distinctive lithological characters throughout areas of any great extent. As this has necessarily been done from a knowledge of only a portion of the fossils characterizing these strata, it is quite probable, when more extensive collections are obtained, that it may be found necessary, even on this principle, to classify and group the beds somewhat differently. We are also aware that some of these beds probably increase or diminish greatly in thickness, or may even entirely thin out, at no very great distances from the localities where we saw them.

Among the more peculiar features of the series of rocks represented by this general section, and in part by the preceding local sections, may be mentioned, first, the great

number of thin layers and beds; and secondly, the frequent repetition of similar beds at various horizons. Again, the almost entire absence of heavy massive strata of limestone, or other hard material possessing sufficient durability to form perpendicular escarpments of much extent, is worthy of note. As a general thing, the limestones vary from only a few inches in thickness, to from one to three or four feet, and rarely, as in Nos. 14 and 18, attain a thickness of from thirty-eight to forty feet. Although various light-colored laminated clays and soft argillaceous shaly beds predominate, and arenaceous material is not unfrequently present, it is somewhat remarkable that dark bituminous shales and beds of coal are rarely met with, even among the outcrops seen along the Kansas, below the mouth of Blue river, belonging to the upper Coal measures, and holding a position below the base of the foregoing general section; while through a considerable thickness of beds belonging to higher portions of the Coal measures included in the lower part of this section, as well as through the strata containing Permian fossils above, beds of coal and dark carbonaceous shales appear to be almost, if not entirely wanting.

It will be observed we have in this general section, without attempting to draw lines between the systems or great primary divisions, presented in regular succession the various beds with the fossils found in each, from the Cretaceous sandstone on the summits of the Smoky hills, down through several hundred feet of intermediate doubtful strata, so as to include the beds containing Permian types of fossils, and a considerable thickness of rocks in which we find great numbers of upper Coal measure forms. We have preferred to give the section in this form because, in the first place, the upper Coal measures of this region pass by such imperceptible gradations into the Permian above, that it is very difficult to determine, with our present information, at what particular horizon we should draw the line between them, while, on the other hand, it is equally difficult to define the limits between the Permian and beds above, in which we found no fossils.

Beginning near the base of this section, we find we have in great numbers the following well-known and widely distributed Coal measure fossils, viz.: *Fusulina cylindrica*,* *Chonetes Verneuiliana*, *Productus splendens* (or a closely allied species), *Retzia Mormonii*, *Rhynchonella Uta*, *Spirigera subtilita*, *Spirifer cameratus*, *S. planoconvexa*, and a *Euomphalus* similar to *E. rugosus* of the Coal measures, while the few new and undetermined species associated with these are, for the most part, also decidedly more nearly allied to Carboniferous than Permian forms. We should here remark, however, that we occasionally met with a species of *Monotis*, allied to the Permian species *M. Speluncaria* and *Synocladia biserialis*, also regarded in the Old World as a Permian genus, at horizons far beneath the

* In Russia, *Fusulina cylindrica* is said to occur only in the upper part of the lower Carboniferous series; but the fossil generally referred to that species in this country appears to be confined to the Coal measures. We have some doubts in regard to its identity with the Russian species.

base of this section, between Manhattan and the Missouri. We even found a single specimen of this *Monotis* as low down as bed No. 9 of the section taken near the landing at Leavenworth city, which must occupy a position several hundred feet below the lowest beds of the above section. Still as this shell is very rare in these lower rocks, and the *Synocladia* is a distinct species from the well-known Permian form of the Old World, while they are both, at these horizons, associated with great numbers of the common well-known Coal measure species, we can only regard their presence in these beds as establishing the existence of these genera at an earlier period in this country than in the Old World. This, it seems to us, is more philosophical than it would be to place all this great thickness of strata, with their vast numbers of well-known Coal measure species, in the Permian, merely because we also find with these occasionally a few forms which would in the Old World be regarded as characteristic of the Permian epoch.

Taking it for granted, then, that we have carried this section down far enough to include, not only all the beds containing almost exclusively Permian forms, but a considerable portion of the upper Coal measures, it will be interesting to notice, as we ascend in the series, how far each of the Coal measure species mentioned in the lower part of the section, as well as of a few others that occur above and below, range upwards. Thus we see that *Fusulina cylindrica* var. *ventricosa*, *Chonetes Verneuiliana*, and *Retzia Mormonii*, were not met with above division No. 37; while *Spirifer planoconvexa*, *Productus splendens?*, and *Rhynchonella Uta*, were not observed above 34, nor *Spirifer cameratus* above 32. *Fusulina cylindrica*, of the slender variety so common in the Coal measures of Kansas and Missouri, was not seen above 22; nor was any species or variety of that genus observed above this horizon.

Apparently the same species of *Monotis*, mentioned at various horizons far beneath, were occasionally met with in 30, 25, 23, and 20, generally associated with the same species of *Synocladia*, ranging far down into the upper Coal measures. In division No. 19, we again met with the *Synocladia biserialis*, and a *Spirigera* allied to *S. subtilita*, if not identical, along with a new species of *Chonetes* we have called *C. mucronata*, which ranges down into the beds near the base of the section. Along with these were also *Productus Norwoodii* and *Orthisina Shumardiana*, both of which are common in the Coal measures far below, and a large *Orthisina* similar to *O. umbraculum*, but apparently more finely striate.

Ascending through the intermediate beds to No. 12, we continue to meet with nearly all the species mentioned in 19, with the exception of *Chonetes mucronata*. We also have, first in 18, a large species of *Productus*, called *P. Calhounianus* by Professor Swallow; very similar to some varieties of *P. semireticulatus*, but thought by Prof. S. to present well-marked internal differences. There is likewise added in 16 a large *Allorisma*, and a *Spiriger* similar to *S. subtilita*, but much more gibbous; and in 14, *Discina tenuilineatus*,

together with apparently the same *Monotis*, so often mentioned below. In 12, we also have added a small *Spirifer*, similar to *S. lineatus*, but perhaps more nearly allied to the Permian species *Martinia Clannyana*, King.

The succeeding bed above, No. 11, appears also to contain a mingling of Permian with Coal measure forms, for we have in it the following Permian types, viz.: *Myalina* very similar to *M. squamosa*, *Pleurophorus? subcuneata*, *Bakevellia parva*, and *Monotis Hawni*, along with a *Euomphalus* near *E. rugosus*, the same gibbous *Spirigera*, similar to *S. subtilita*, *Orthisina umbraculum?*, and *O. Shumardiana*.

On passing into the next division above, No. 10, we find we have lost sight of all the characteristic Carboniferous forms, unless the *Spirigera* mentioned in some of the beds below be regarded as only a variety of *S. subtilita*, from which, however, we think it specifically distinct; for with this exception, nearly all the fossils seen by us in this division are such as would be regarded as Permian types. Although the number of *species* found by us in No. 10 is not great, *individual* specimens are often numerous. Above this horizon we saw no more fossils through a great thickness of various colored clays, claystones, &c., until ascending to the Cretaceous sandstones crowning the Smoky hills.

If we do not admit the existence in this region of an intermediate group of rocks, connecting by slight gradations the Permian above with the Coal measures below, and must draw a line somewhere, below which all is to be regarded as Carboniferous, and all above as Permian, we should certainly, upon palæontological principles alone, carry this line up as far as the top of division No. 11. The passage from the Carboniferous to the strata containing Permian types, however, is so gradual here, that it seems to us no one, undertaking to classify these rocks without any knowledge of the classification adopted in the Old World, would have separated them into distinct *systems*, either upon lithological or palæontological grounds, especially as they are not, so far as our knowledge extends, separated by any discordance of stratification, or other physical break.* Indeed, the fact that some of the Permian types occurring in No. 10, were first introduced in beds below this, containing many Carboniferous species, would seem to indicate that even No. 10 may possibly have been deposited just before the close of a period of transition from the conditions of the Carboniferous, to those of the Permian epoch.

The apparent absence of fossils in the beds above No. 10, renders it impossible, with our present information, to determine with certainty the upper limits of the series contain-

* We have been informed by Dr. J. G. Norwood, former State Geologist of Illinois, that the rocks in that State, referred by him and others to the same epoch as the Kansas Permian beds, rest unconformably upon the Coal measures. This, however, would be impossible in Kansas, since no disturbances of the strata occurred there, until after the close of the Cretaceous era, which would, of course, not only cause the Cretaceous and Carboniferous, but all intermediate beds, to dip at the same angle.

ing Permian forms. It is true there is at places a kind of conglomerated mass, occupying the horizon No. 9, which might appear to form a natural line of division between the beds containing the Permian fossils, and those above, in which we found no organic remains; but this seems to be local, and although there is a new feature presented by the zone of gypsum deposits above it, we find between the beds and layers of gypsum, and far above the horizon at which they occur, bluish, greenish, and other colored clays, not only similar to those between the beds and layers of limestone containing the Permian fossils in division No. 10, but also precisely like the laminated clays between the beds of limestone of the upper Carboniferous series far below. Again, in these clays of the gypsum zone, as well as through a considerable thickness of clays above it, there are occasional seams of claystone, which sometimes pass into seams of magnesian limestone, exactly like some of those containing Permian fossils, in division No. 10. We saw no fossils in these seams amongst the gypsum-bearing beds, nor higher in the series, but it is probable they may yet be found in some of the more calcareous portions.

Another fact apparently indicating some kind of relation between the gypsum-bearing beds, as well as some of the higher deposits, and the rocks below, is, that we often find, both in the clays between the beds of gypsum, and those between the limestone containing the Permian fossils, the same peculiar appearance, caused by the cracking of the clays and subsequent infiltration of calcareous matter, seen in division No. 5. At some places the thin plates of limestone formed by the impure calcareous matter filling these cracks, may be seen ramifying through some rather thin beds of these clays in all directions, so as to cross and intersect each other at every angle. Where beds of this kind have been exposed for any length of time along near the tops of bluffs, the softer clays filling the interstices often weather out, so as to have a curious cellular mass, with the numerous angular cavities.

From these facts we are inclined to suspect,—though we are fully aware that it is a question which can only be determined upon evidence derived from organic remains,—that not only the gypsum-bearing deposits, but a large portion, if not all, of division No. 5, belongs to the same epoch as the beds containing the Permian fossils below.

Between No. 5 and the Cretaceous above, there is still a rather extensive series of beds in which we found no organic remains; these may be Jurassic or Triassic, or both, though, as we have elsewhere suggested, we rather incline to the opinion that they may prove to belong to the former. As we have fully discussed the question in regard to the Cretaceous age of the highest division of the foregoing section in a paper read before the Academy in December last, and in an article in the American Journal of Science, January, 1859, it is unnecessary for us to add anything further on that subject here.

As already stated, our observations along the Kansas valley, to within twelve or four-

teen miles of the mouth of the Big Blue river, were too isolated to determine in all cases the relations between outcrops seen at different places. Consequently, although we saw at several points along this part of the valley indications of a westward or northwestward inclination of the strata, we were left in some doubt whether or not there is a general inclination of the rocks in that direction, between Wabounse and the Missouri. Above this point, however, our observations being more connected and the exposures more continuous, we were able to determine very satisfactorily that there is at least from near Wabounse, a uniform dip towards the west or northwest, so that in ascending the Kansas valley from this region we are constantly meeting with more and more modern rocks, as those we leave behind pass beneath the level of the Kansas.

To illustrate this more clearly, we would, in the first place, remark that a bed of light grayish yellow granular magnesian limestone, occupying a horizon about 115 feet above the Kansas, two or three miles west of Zeandale, passes beneath the level of the Kansas before reaching the mouth of the Big Blue river, a distance of near seven miles; while another bed (No. 26 of the foregoing section) seen on the very summit of the hills two or three miles north of Zeandale, at an elevation of about 320 feet above the Kansas, was observed opposite Manhattan at the mouth of Big Blue river, only some 214 feet above the Kansas. Again, bed No. 12 of the foregoing general section, which was seen at a locality nearly opposite Ogden, at an elevation of about 363 feet above the Kansas, is at Fort Riley, eight or nine miles further west, elevated only some 215 feet above the Kansas. Above Fort Riley this bed forms a marked horizon, and can be followed by the eye without interruption for several miles along the hills on both sides of the river. We observed it gradually sinking as we ascended the Kansas valley, until at a point on Chapman's creek, some fifteen miles a little south of west from Fort Riley, we saw it nearly down on a level with the Kansas; beyond this it was not again met with on the north side of the Kansas, but we saw it at somewhat higher elevations on the south side of the river a little west of this.

As the distance by an air-line, from the locality nearly opposite Ogden, where this rock occupies a horizon at an elevation of 363 feet above the Kansas, to the mouth of Chapman's creek, is about 23 miles, the dip would appear to be not far from 15½ feet to the mile. It must be borne in mind, however, that the average fall of the Kansas,—at least below Fort Riley,—according to the barometrical observations of Col. Fremont and others, is near one and a half feet to the mile, and that if we assume the distance by the windings of the river between Chapman's creek and Ogden, to be about thirty miles, it would make the elevation of the Kansas at the former locality some forty-five feet greater than at Ogden, which would reduce the dip to a fraction less than 14 feet to the mile. Still as the direction of the dip in this region is to the *north* of west, and the direction of the

mouth of Chapman's creek from Ogden is considerably *south* of west, it is probable the inclination of the strata here is greater than the above figures would indicate, and that it may not be less than twenty feet to the mile, in a northwest direction.

From the foregoing statements it will be seen that in consequence of the dip of the strata to the northwest, and in some slight degree to the fall of the Kansas and Smoky Hill rivers, the whole of the foregoing general section below No. 12 passes beneath the level of the Smoky Hill, between the mouth of Blue river and Chapman's creek. Consequently, the limestones of the succeeding beds above being thinner and less durable than those below, and separated by heavy beds of clay, we find, as might be expected, that the country here in the region of the mouth of Chapman's creek, is much lower than at Fort Riley and below.

On reaching the mouth of Solomon's fork, we found the face of the country characterized by long gentle grassy slopes, no part of it near the river being apparently elevated more than about 60 or 70 feet above its surface. A short distance beyond this, we caught the first glimpse of the Smoky hills, which were seen in a direction a little south of west from us, rising above the surrounding low country like dark blue clouds above the horizon. On approaching these, we found them always situated several miles back from the river, and rising some three hundred and fifty feet above it. The immediate bluffs of the river here, are generally composed of divisions No. 4 and 5 of the foregoing general section, and that portion of these hills above the level of the summits of the bluffs along the river, is made up of division Nos. 3, 2, 1, of the same section. On the south side of the river these hills have but a comparatively thin capping of the sandstone No. 1, but on the north side we saw it showing a thickening on some of them of sixty feet.

From some of these hills on the north side of Smoky Hill river, between it and the Grand Saline, we had an extensive and beautiful view of the surrounding country. In the north and northwest, many similar hills were in sight, and as the dip of the strata here is in that direction, it is probable some of them are not only chiefly made up of the sandstone No. 1, but surmounted by the other Cretaceous beds Nos. 2 and 3 of the Nebraska Cretaceous series; indeed, Mr. Engleman found all these formations occupying this relation on Republican river, not more than seventy miles north of this.*

Although this paper is merely designed to give a brief sketch of the leading geological features of those portions of Northeastern Kansas visited by us, we cannot close it without alluding to the truly great agricultural and other natural resources of this new and interesting territory. We mean no disparagement to other portions of the Mississippi valley, when we state, that after having travelled extensively in the Great West, and after having

* See Report of Secretary of War, Dec. 5th, 1857, page 497.

seen many of its most favored spots, we have met with no country combining more attractive features than Kansas territory. Her geographical position gives her a comparatively mild and genial climate, intermediate between the extremes of heat and cold, while the rich virgin soil of her beautiful prairies is admirably adapted to the growth of all the great staple grain and root crops of the West.

It is true that in some districts there is rather a deficiency of timber, but as a general thing there is along the streams sufficient for the immediate wants of the country. In addition to this, the wonderful rapidity with which forests are known to have sprung up on similar prairie lands in Missouri, as the country became settled so as to keep out the annual fires, shows that the present scarcity of timber should not be regarded as presenting any serious obstacle to the settlement of the most extensive prairie district in Kansas.

Before going out into the interior of the Territory, we had expected to find the whole country immediately west of Fort Riley comparatively sterile; on the contrary, however, we were agreeably disappointed at meeting with scarcely any indications of decreasing fertility as far as our travels extended, which was about sixty miles west of Fort Riley. Here we found the prairies clothed with a luxuriant growth of grass, and literally alive with vast herds of buffalo, that were seen quietly grazing as far as the eye could reach in every direction. Even on the high divide between the Smoky Hill and Arkansas rivers, south of this, we found the soil rich and supporting a dense growth of grass; and from all we could learn from persons who have gone further out, the same kind of country extends for a long distance beyond this, towards the west. Hence we infer that the belt of unproductive lands between the rich country on the east, and the eastern base of the Rocky mountains on the west, is much narrower than is generally supposed; and even this so-called desert country is known to possess a good soil, which may be rendered fruitful by artificial irrigation.

In regard to the mineral resources of Kansas, we have at present only time and space to say a few words. As already stated, coal is known to exist, though its extent is not yet fully determined, at several localities in the region of Leavenworth city, while the geological structure of the country, as well as discoveries already made, warrant the conclusion that this important and useful mineral abounds at many localities south of there. Limestone suitable for building purposes, and the production of quicklime, exists throughout large areas, while inexhaustible beds of gypsum are known to occur at several places not far west of the mouth of Solomon's river. Near this place we likewise saw in the lower Cretaceous rocks crowning the summits of the Smoky hills, deposits of iron ore, but were unable to determine, in the limited time at our command, whether or not it exists in large quantities.

Of the discoveries of gold in the mountains on the western borders of Kansas, much has

been said; nothing, however, but a thorough geological survey, by authority of the Territorial or State government (for Kansas must soon be a State), can lay before the public such full, accurate, and reliable information on these subjects as will bring from the older States the capital, skill and enterprise necessary to develop the great natural resources of the country.

Leaving the Territory of Kansas we find that the southeastern portion of Nebraska is underlaid by limestones of the upper Coal measures. Having already described these rocks in detail as they occur in Nebraska in a preceding chapter, I shall simply allude to them here in a general way. The town of De Soto is the highest point known on the Missouri river where these limestones are exposed. Ascending the valley of the Platte river we find them quite well developed as far as the mouth of the Elkhorn, where they pass beneath the water level of the river and are succeeded by the sandstone of Cretaceous formation No. 1. Both the fossiliferous contents and lithological characters of these limestones show that they form the northwestern continuation of the series of rocks which seem to be distributed to a greater or less extent over Iowa, Kansas, Illinois, Indiana, Missouri, Ohio, and portions of Pennsylvania. Leaving De Soto the Carboniferous limestones do not again appear along the Missouri river until we reach the vicinity of the mountains, where it is probable that they are revealed in the form of outcropping belts around the mountain elevations, though no evidence from actual observation has yet been published to the world sustaining the inference. Ascending the Platte river we find that the whole country from the Elkhorn to Fort Laramie is occupied by rocks of Cretaceous and Tertiary age, and not until we reach the Laramie mountains do we again meet with the Carboniferous limestones, which here form an outcropping zone, exposed by the upheaval of the older rocks. In the Black hills we again find them exposed around the nucleus of elevation with the same fossils and lithological characters as at the Laramie mountains. From these facts, and the accounts of explorers in the North and South, there is good reason for the inference that the Carboniferous rocks are probably co-extensive with the great central range of the Rocky mountains. This subject will be again alluded to in a subsequent portion of this report. The following catalogue embraces all the Carboniferous and Permian fossils obtained by the writer at Fort Laramie, Black hills, and Southeastern Nebraska; also those collected by Mr. Meek and the writer in the Kansas valley. The catalogue published in our paper to the Philadelphia Academy, January, 1859, has been used, with the additions of species found in the far West, with their geographical distribution. The descriptions of the new species have been omitted. This catalogue does not assume to be complete, but only to embrace such fossils as are in our possession so far as they have been determined.

Foraminifera.

Fusulina cylindrica, Fischer, Oryct. Moscow, p. 126, p. 18, figs. 1–5.

In Russia this species is said to occur only in the upper part of lower Carboniferous or mountain limestone. Yet the species usually referred to *F. cylindrica* in this country, so far as our knowledge extends, is not found below the Coal measures. From this fact, and some slight differences we observe between our specimens and the figures of the Russian species, we suspect a careful comparison of good specimens may possibly prove them to be distinct. Ranges in Kansas from Division No. 22, of the foregoing section, far down into the Coal measures. Found at numerous localities between Manhattan and the Missouri, usually in great numbers. Also occurs in vast numbers in the southwestern part of Iowa and in Missouri. Dr. George Shumard has discovered a remarkable species of *Fusulina* in the white limestone of the Guadalupe mountains upwards of an inch in length, which he considers distinct and has been named by his brother *F. elongata.*

Fusulina cylindrica, var. *ventricosa*, Meek and Hayden, Proc. Acad. Nat. Sci. Phila. December, 1858, page 261. Division No. 37 of foregoing general section, at Manhattan on the Kansas, and at Juniata on Big Blue river.

Bryozoa.

Synocladia biserialis. Prof. Swallow refers this species with doubt to *S. virgulacea*, Phillips, sp. in Transactions Acad. Sci. St. Louis, vol. i, p. 179, and points out some of the characters in which it differs, stating at the same time, in case it should prove to be distinct, that *biserialis* would be a good specific name for it. We regard it as quite distinct from Phillips's species, not only in scarcely ever having more than two rows of cellules, but also because the ? gemuliferous vesicles, instead of being merely "tubercular and open at the summit," have the form of short, but distinct spines, apparently closed and rather obtusely pointed at the apex. The branches or connecting process are likewise less distinctly angulated between the longitudinal stems than in *S. virgulacea.* Occurs at Fort Riley in No. 19 of foregoing general section, and at various lower horizons on the Kansas below there, down into the upper Coal measures.

Acanthocladia Americana. In the Trans. Acad. Sci. St. Louis, vol. i, p. 180, Prof. Swallow refers this species with a query to *A. anceps*, Schlot. sp. and remarks that it differs from that species in having "the rows of cellules diagonal to the axis of the stems, instead of longitudinal, as represented by King, and on ridges like that figured by Goldfuss." He also further remarks that "it is less regularly branched, and not so distinctly pinnated as those delineated by Goldfuss and King." In the specimens in our collection, the cellules are more numerous and much more crowded than in *A. anceps*, as figured by King. The specific name *Americana*, was suggested by Prof. Swallow.

We found this species in Division No. 18 of the foregoing general section, on Cottonwood creek.

Echinodermata.

Cyathocrinus ——*?* A few scapular plates, bearing some similarity to those of *C. ramosus*, Schlot. sp. were met with by us in Division No. 18, but they are proportionably much thicker, and the articulating surfaces quite different. Cottonwood creek.

Archæocidaris ——*?* In No. 12, we found spines and detached plates of apparently an undescribed species of this genus, but they were too much weathered to show clearly the specific characters. The spines are rather slender, terete, nearly straight, and provided with short scattering spinous processes, directed rather obliquely outwards and forward. Cottonwood creek.

Archæocidaris ——*?* The spines of this species are much larger than the last, and apparently destitute of

spinous processes. They are as much as from three to four inches in length, nearly or quite straight, and not flattened or compressed.

Division No. 26, Manhattan, and in same position on Cottonwood creek.

Brachiopoda.

Discina tenuilineata, Meek and Hayden, Proceedings Acad. Nat. Sci. Pa. p. 25, January, 1859. Cottonwood creek, Division 16.

Discina Manhattanensis, Meek and Hayden, Proceedings Acad. Nat. Sci. Pa. p. 25, January, 1859. Found in great numbers in Division No. 37, opposite Manhattan on Kansas river.

Productus splendens (*?*), Norwood and Pratten, Jour. Acad. Nat. Sci. Phila. N. S. vol. iii, pl. fig. 5. We refer this shell to the above species with some doubt; it is always smaller than the figure given by Norwood and Pratten, and rather more convex over the visceral region of the larger valve, while the smaller valve appears to want the band-like flattening around the border mentioned in the description of *P. splendens*. The ears extend beyond the body of the shell, are distinctly vaulted, and rarely have more than one spine on each, often none. The spines, however, are more numerous over the surface of the larger valve, being in this respect more like *P. muricatus* N. and P., but both valves want the concentric wrinkles represented in the figures of that species.

This neat little *Productus* is found in great numbers between Fort Riley and Manhattan, as well as at the latter place, in Division No. 34; also at various horizons below that in the upper Coal measures of Kansas; also in Missouri, and along the Pecos river, in New Mexico.

Productus Norwoodi, Swallow, Trans. Acad. Sci. St. Louis, vol. i, p. 182. A few specimens of this species in our possession have the extreme point of the beak of the larger valve flattened or truncate, as though it had in the young state been attached to some marine body by that part of the shell. We have also in several instances found other shells associated with this species, with small discs not more than 0.20 inch in diameter, attached by the whole surface, as well as by a series of small spines seen radiating from the margin. May not these little bodies be the young of this species?

We think the specimen figured by Prof. Marcou in his work on the Geology of North America, plate 6, fig. 1, as *P. pustulosus*, is the same as the above species, and quite distinct from *P. pustulosus*. It occurs in Kansas at various horizons from No. 14 far down in the upper Coal measures. We found it at Fort Riley and numerous places between there and the Missouri, as well as at Leavenworth city.

Productus Rogersi, Norwood and Pratten, Jour. Acad. Nat. Sci. Phil. N. S. vol. iii, page 9, pl. 1, fig. 3. This species is nearly related to the last, and when the shell is exfoliated, may be easily confounded with it. *P. Norwoodi*, however, appears never to have the distinct concentric wrinkles of this species, nor do the pustules at the base of the spines have the tendency to elongate into indistinct ribs as in *P. Rogersi*. Prof. Marcou has figured in N. Am. Geol. pl. 5, fig. 6, as *Productus scabriculus*, a shell very like this.

Kansas valley below the mouth of Blue river, in upper Coal measures; at the Pecos villages in the Coal measures or upper Carboniferous limestone.

Productus pustulosus (*?*), Phillips's Geol. Yorkshire, vol. ii, p. 316, pl. 7, fig. 15. We have a specimen agreeing very nearly with this species in its external markings, but it is much narrower, and the beak of the larger valve more extended, in which respect it differs quite as much from *P. punctatus*.

Near Steamboat landing at Leavenworth city, in Coal measures.

Productus Prattenianus, Norwood, Jour. Acad. Nat. Sci. Phil. N. S. vol. iii, p. 17, pl. 1, fig. 10. In Coal measures at Indian creek and at Leavenworth city.

Productus Calhounianus, Swallow, Trans. Acad. Sci. St. Louis, vol. i, p. 181. This fine large shell is scarcely

distinguishable from *P. semireticulatus* var. *antiquus*, but Prof. Swallow, who has seen the interior, thinks it presents well-marked internal differences. It occurs in No. 12 and below, at Fort Riley, also on Cottonwood creek. Prof. S. thinks it even ranges down into the lower Carboniferous.

Chonetes Verneuiliana, Norwood and Pratten, Jour. Acad. Nat. Sci. Phila. vol. iii, p. 26, pl. 2, fig. 6, N. S. Occurs in Kansas in Division No. 37, at Manhattan, and perhaps in upper Coal measures at lower horizons.

Chonetes mucronata, Meek and Hayden, Proceed. Acad. Nat. Sci. Phila. Dec. 1838, page 262. Lower part of the section at Fort Riley (Division 9), and down near the base of the foregoing general section, also in same position on Cottonwood creek.

Orthisina crassa, Meek and Hayden, Proceed. Acad. Nat. Sci. Phila. Dec. 1858, p. 261. Occurs in Coal measures near landing at Leavenworth city.

Orthisina umbraculum? Schlot. sp. Petrefakt. 1, p. 256, et 2, p. 67. We find in Kansas, ranging from 16 to 19 of foregoing sections, many specimens of a large species of *Orthisina*, having almost exactly the form and other characters of *O. umbraculum*, excepting that the striæ appear to be more numerous. According to Koninck that species has about 108 striæ on each valve, while on our Kansas specimens, we count from 160 to 200; consequently we suspect it may be a distinct but closely allied species; if so, we would propose to designate it by the name of *O. multistriata*. We found it at Fort Riley and at several localities between there and Blue river; also in same position on Cottonwood creek.

Orthisina Missouriensis, Swallow, Trans. Acad. Sci. St. Louis, vol. i, p. 219. This is a very peculiar plicated species, often much distorted. When partly embedded in the matrix, it frequently bears a striking resemblance to *Plicatula striato-costata*, Cox, vol. iii. Dr. Owen's report on the Geol. Survey of Kentucky, page 558, pl. 8, fig. 7, of Atlas. Common in the upper Coal measures of Kansas, at Leavenworth city and west of there.

Orthisina Shumardiana, Swallow, Trans. St. Louis Acad. Sci. vol. i, p. 183. Although like the last, a plicated species, this is more symmetrical, and presents other well-marked differences. Ranges from No. 11 down some distance in upper Coal measures. Found at Fort Riley and between there and Blue river.

Terebratula millepunctata, Hall, Pacific Railroad Report, vol. iii, p. 101, plate 2, figs. 1, 2. We have the impression that this species is probably identical with *T. bovidens*, Morton (Silliman's Jour. vol. xxix), from Ohio. Our Kansas specimens appear, however, to be more elongated than those figures by Dr. Morton, and may be distinct. In form they resemble very much some varieties of *Epithyris elongata*, Schlot. sp. as figured by King, in Perm. Fos. Eng. pl. 6, particularly the narrower varieties, such as fig. 35. The beak of our Kansas shell, however, is not truncate but pointed, the perforation being on the outside, and a little removed from the extremity. If it is identical with *T. bovidens*, Morton's specific name will have to take precedence, being the older. It remains to be determined whether its internal characters agree with *Terebratula*, as now restricted.

This is a rather common form in the upper Coal measures of Kansas, and southward. We found it near the summit of the hills back of Leavenworth city, also at Indian creek, near Indianola, &c. It is also found at Pecos village (New Mexico), associated with *Spirigera*, *Subtileta*, *Spirifer cameratus*, and *S. lineatus*.

Rhynchonella Uta (*Terebratula Uta*, Marcou, Geol. N. A. p. 51, pl. vi, fig. 12). We have from the upper Coal measures in Kansas many specimens of a species agreeing exactly with Prof. Marcou's description of the above species. These we suspect may possibly go into the genus *Camerophoria*, King, if not into *Rhynchonella*; at any rate they are certainly not *Terebratula*. We are inclined to the opinion that a shell described by Prof. Swallow, in the Trans. Acad. Sci. St. Louis, vol. i, p. 219, under the name of *Rhynchonella* (*Camerophoria*) *Osagensis*, may be identical also with the above; yet Prof. S. says his species has from "two to six" plications in the sinus of the dorsal valve, while in the shell before us, of which we have quite a number of specimens, there are *invariably* but two plications in the sinus.

Quite common in Division No. 94 at Manhattan and at several localities between there and the Missouri, in the upper Coal Measures. Prof. Marcou cites it as a mountain limestone species, but we know nothing of its existence in rocks of that age. This species was also found by Mr. Marcou near Great Salt Lake city, associated with *Retzia Mormonii, Terebratula Royssii*, and *S. subtilita*. Also in the limestones near Fort Laramie.

Retzia Mormoni (*Terebratula Mormonii*, Marcou, Geol. N. A. p. 51, pl. vi, f. 11). We found this species quite abundant in Division 37 at Manhattan, where it is associated with the last. It also ranges far below this in the upper Coal measures between Manhattan and the Missouri, being quite common near the summits of the hills back of Leavenworth city. Dr. B. F. Shumard has described a species in the Trans. Acad. Sci. St Louis, under the name of *Retzia punctilifera*, which we suspect may possibly be a variety of the above; but as he describes it as having usually in the dorsal valve "a moderately wide, shallow sinus, which extends from the front nearly to the beak," and the species before us, of which we have many specimens, has no traces of a sinus, we are left in doubt. In other respects his description agrees exactly with our shell, and he also states that he has it from K. T. Prof. Marcou found this species at the Salt Lake city, Utah, in a rock he refers to the mountain limestone. We have never seen it from below the Coal measures. It is also found near Fort Laramie, Nebraska, and in the Carboniferous limestones of the Black hills.

Spirifer Kentuckensis, Shumard, Geol. Survey of Missouri, part 2, p. 203. Found in upper Coal measures near the top of bluffs, back of Fort Leavenworth, also near the landing at Leavenworth city, and at other localities between the Missouri and Blue river.

Spirifer cameratus, Morton, American Jour. Sci. vol. xxix, p. 150, pl. 11, fig. 3. This is the same species, as has been determined by Prof. Hall, described by Dr. Roemer as *S. Meusebachanus* (Kreid von Texas, p. 88, pl. 11, fig. 7), and subsequently by himself as *S. triplicatus*, in Stansbury's Rept. p. 420, pl. 4, fig. 5. Prof. Marcou has recently figured it in his work on the Geol. North America, p. 49, pl. 8, fig. 3, as a variety of *Spirifer striatus*, Martin, from which it is quite distinct. He found it at Pecos village in a rock he refers to the lower Carboniferous or mountain limestone. It has a great geographical range, being common in the Coal measures from Pennsylvania to the Rocky mountains, and from Nebraska to New Mexico; we have never seen it, however, from lower Carboniferous rocks. It is very common near Bellevue, Nebraska, at Fort Laramie, and in the Black hills.

Spirifer hemiplicata, Hall. Stansbury's Report, p. 409, pl. 4, fig. 3. Upper Coal measures near summit of hills back of Leavenworth, and at other localities between there and Blue river.

Spirifer lineatus. Anomites lineatus, Martin. *Spirifer lineatus* of Phillips. Geol. Yorks. ii, p. 219, pl. 10, fig. 17, and of other authors. We have, from near Leavenworth landing, in the Coal measures, a Spirifer, apparently identical with the above. It appears not to range very high in the upper Coal measures of Kansas.

Spirifer ——. In Division No. 12, above Fort Riley, we found a few imperfect specimens of a small, smooth *Spirifer*, similar, in some respects, to *S. lineatus*, but apparently more like *Martinia Clannyana*, King, from the Permian of England.

Spirifer planoconvexa, Shumard. Geol. Report, Missouri, 2d part, p. 202. We found this handsome little shell quite abundant in the upper Coal measures (Divisions 34 and 37) at Manhattan; also at Juniata, on Big Blue river, and near summit of hills back of Leavenworth city.

Spirigera subtilita. (*Terebratula subtilita*, Hall. Stansbury's Report, p. 409, pl. 4, figs. 1–2.) *Spirigera subtilita*, of Dr. George Shumard. Trans. St. Louis Acad. Sci. vol. i.

This is a very abundant species in Kansas; we found it ranging up at least as far as Division No. 37, at Manhattan, and met with some obscure forms resembling it still higher in the series. From these horizons, it ranges far down in the other members of the Coal measures. Several of our specimens collected at Leavenworth city show that it was provided with internal spiral appendages, as in the *Spirifer*, and consequently cannot remain in the

genus *Terebratula*, as now restricted. It has a wide geographical range, and is almost everywhere the companion of *Spirifer cameratus*. Prof. Marcou figures it in his work on the Geology of North America, pl. 6, fig. 9, from a formation in the Rocky mountains, which he refers to the lower Carboniferous; but we have never seen it from any position below the Coal measures.

Spirigera ——*?* At Fort Riley, and above there, as well as in the same position on Cottonwood creek, we found, ranging from Division 18 up to 10 of the foregoing section, a *Spirigera* resembling *S subtilita*, but much more gibbous in form; it also appears to have a much thicker shell. If distinct from *S. subtilita* this might be designated by the specific name *gibbosa*.

Lamellibranchiata.

Monotis Hawni, Meek and Hayden. Trans. Albany Inst. vol. iv, March 2, 1858. Prof. Swallow thinks this species not distinct from *M. speluncaria*, Schlot. sp. Although, like that species, it is quite variable, and some of its varieties are very similar to it; after a careful comparison of a large number of individuals with King's figures and descriptions, we still regard it as distinct. We have never seen any of its various forms with the beak of the larger valve elevated so far above the hinge, as in figs. 5, 6, 7, and 8, pl. 13, of King's work. Nor do any of our specimens possess the peculiar oblique posterior sulcus seen in the figures cited above. High country, south of Kansas falls; also above there, on Smoky Hill river and Cottonwood creek, in Division 10.

Myalina (*Mytilus*) *perattenuata*, Meek and Hayden. Trans. Albany Inst. vol. iv, March 2d, 1858. Our description of this species was made out from one of the more slender varieties of this shell, sent to us from near Smoky Hill river by Mr. Hawn. We were probably wrong, however, in referring to it a specimen in our possession from a locality on the Missouri, opposite the northern boundary of Missouri; and we even suspect the rock from which this latter specimen was obtained may belong to an older epoch.

The species above cited is, we think, identical with *M. permianus* of Swallow, Trans. Acad. Sci. St. Louis, vol. i, p. 187. And we also suspect the form he describes in the same paper as *Mytilus* (*Myalina*) *concavus*, is only a broader variety of the same; at any rate we have these two forms, and every intermediate gradation between them, from the same bed. Locality and position same as the preceding.

Myalina squamosa. (*Mytilus squamosa*, J. de C. Sowerby. Morris's Catalogue, p. 93. *Myalina squamosa* of some other authors.)

Of the form, we refer with doubt to the above species; we have but one imperfect specimen. As far as the characters can be made out, it agrees with this species. We found it in Division No. 11, at Kansas falls, above Fort Riley.

Myalina subquadrata, Shumard. Missouri Geol. Rept. 2d part, p. 207, pl. c, fig. 17. Upper Coal measures, Leavenworth city, on the Kansas, at Lawrence and other localities in Kansas valley, below mouth of Big Blue river.

Edmondia? Calhouni, Meek and Hayden. Trans. Albany Inst. vol. iv, March 2, 1858. We are still in doubt in regard to the generic relations of this species, having procured no better specimens than that first described by us. We suspect it may be a *Cardinia*. Near Smoky Hill river, in Division 10.

Bakevellia parva, Meek and Hayden. Trans. Albany Inst. vol. iv, March 2, 1858. This is probably the same species referred by Prof. Swallow to *Avicula antiqua*, Munster,—*Bakevellia antiqua* of King, and others. In describing this species, we spoke of its very near relation to *B. antiqua*, but pointed out some characters in which it differs. At that time we had seen but a few imperfect specimens; since then, however, we have obtained many others, a careful examination of which causes us still to regard it as distinct from *B. antiqua*. Of a large number of individuals, we have never seen any one-half the size of the smallest, nor one-eighth the size of the largest figures

of that species given by King, while the cardinal area is also proportionably much narrower in our shell. Division No. 10. On Smoky Hill river and Cottonwood creek.

Area carbonaria, Cox. Vol. iii, Geol. Report Ky. p. 567, pl. 8, fig. 5. Our fossil is smaller and less distinctly striate, but exactly the form of the above. Near Leavenworth landing, Coal measures.

Leda subscitula, Meek and Hayden. Trans. Albany Inst. vol. iv, March 2, 1858. Division No. 10. Smoky Hill river and Cottonwood creek.

Pleurophorus? subcuneata, Meek and Hayden. Trans. Albany Inst. vol. iv, March 2, 1858. Our specimens of this species being casts we are left in doubt in regard to its generic relations. We suspect it may be a *Cardinia*. Same locality and position as preceding.

Axinus (*Schizodus*) *ovatus*, Meek and Hayden. Proceed. Acad. Nat. Sci. Phila. December, 1858. This is very much like the Permian forms, *S. rotundatus* and *S. truncatus*, but we found it in a rock on Cottonwood creek which we regard as below the Permian.

Axinus rotundatus, Brown. Trans. Manch. Geol. Soc. vol. i, p. 31, pl. 6, fig. 29. We have referred this little shell to the above species with some doubt, but we have seen no characters by which it can be distinguished. No. 10. Near Smoky Hill river.

Allorisma? Leavenworthensis, Meek and Hayden. Proc. Acad. Nat. Sci. Phila. December, 1858, p. 263. Upper Coal measures, Leavenworth city.

Allorisma subcuneata, Meek and Hayden. Proceed. Acad. Nat. Sci. Phila. December, 1858, p. 263. Locality and position same as last.

Allorisma? altirostrata, Meek and Hayden. Proceed. Acad. Nat. Sci. Phila. December, 1858, p. 263. Upper Coal measures, Grasshopper creek.

Allorisma? Cooperi, Meek and Hayden. Proceed. Acad. Nat. Sci. Phila. December, 1858, p. 264. (*Panopæa Cooperi*, Meek and Hayden. Trans. Albany Inst. vol. iv, March 2, 1858.) Near Helena, in upper Coal measures.

Leptodomus granosus, Shumard. Trans. Acad. Sci. St. Louis, vol. i, p. 207. Upper Coal measures, near summit of hills, back of Leavenworth city; also near Leavenworth landing.

Gasteropoda.

Pleurotomaria humerosa, Meek and Hayden. Proceed. Acad. Nat. Sci. Phila. December, 1858. In upper Coal measures, at Grasshopper creek.

Pleurotomaria subturbinata, Meek and Hayden. Proceed. Acad. Nat. Sci. Phila. December, 1858, p. 264. Locality and position same as last. In the Proceedings of the Academy above cited, the locality of this species is *erroneously* given as at Helena.

Bellerophon ——*?* We found a small undetermined species of this genus in Division 10. On Smoky Hill river and near Cottonwood creek; also casts of a large species at Leavenworth landing and Grasshopper creek, in the upper Coal measures.

Euomphalus ——*?* The species here alluded to was found in Nos. 11 and 37 of the foregoing general section. Either it or a very closely allied species also ranges far below this in the upper Coal measures. It is nearly related to, if not identical with a species Prof. Hall has described in the Iowa Report, under the name of *E. rugosus*.

Cephalapoda.

Nautilus eccentricus, Meek and Hayden. Trans. Albany Inst. vol. iv, March 2, 1858. Smoky Hill river, Division No. 10.

FISHES.

Xystracanthus arcuatus, Leidy. Upper Carboniferous rocks at Leavenworth landing.

Cladodus occidentalis, Leidy. Division No. 37 of foregoing general section. At Manhattan.

Petalodus Alleghaniensis, Leidy. Jour. Acad. Nat. Sci. vol. iii, p. 161. Division No. 10 of foregoing general section. Fort Riley.

CHAPTER X.

V. JURASSIC SYSTEM.

The Black hills have up to this time afforded the most satisfactory evidence of the existence of this system in the West. It is there brought to the surface by the upheaval of the older rocks in the form of a belt or zone, five to fifteen miles in width, engirdling the principal axis of elevation. The group of rocks, which we have supposed to belong to this period, are characterized by beds of variegated argillaceous and calcareous grits, sand and sandstone, with seams and beds of gypsum, varying from one inch to twenty feet in thickness. The gypsum seems to form a portion of a series of brick-red beds, composed of argillaceous and calcareous grits, which give a remarkably picturesque appearance to the external features of the country, where these Jurassic rocks are exposed. None of the organic remains already discovered, which are quite numerous in species, are positively known to be identical with those found in rocks of the same age in the Old World, but they belong to the same genera, and many of the species are so closely allied to forms characteristic of the Jura of Europe, that we cannot now hesitate to admit this system into our series. In a paper by F. B. Meek and the writer, published in the Proceedings of the Academy of Natural Sciences of Philadelphia, March, 1858, the following list of fossils was given with comparisons showing their affinities to well-known Jurassic forms. This evidence I will here repeat with such additional proof as I have been able to secure by our investigation of the undescribed fossils in the collection up to the present time.

1. *Pentacrinus asteriscus*, Meek and Hayden, is so nearly like the Liassic *P. scalaris* (Goldfuss), that it is with some hesitation we have regarded it as new.

2. *Avicula* (*Monotis*) *tenuicostata*, M. and H., is very closely related to *M. substriata* of Munster, from the Lias.

3. *Arca* (*Cucullæa*) *inornata*, M. and H., is very similar to C. Munsteri (Zeiten), also from the Lias.

4. *Panopæa* (*Myacites*) *subelliptica*, M. and H., is similar to the Liassic forms *M. liasensis* and *M. Alduinensis* of Quensted.

5. *Ammonites cordiformis*, M. and H., is of the same type as the Oolitic species *A. cordatus* (Sowerby).

6. *Belemnites densus*, M. and H., is scarcely distinguishable from the Oolitic species *B. excentricus* (Blairville), if indeed it is really distinct.

Among the undescribed fossils from the supposed Jurassic rocks of the Black hills, are a species of *Hettangia*, a genus not known to occur in the Old World in formations newer than the Lias, an *Ostrea*, scarcely distinguishable from a form figured by Quensted in his work on the Jura, and a *Trigonia* more nearly resembling Jurassic types than those of any other formation.

VI. Cretaceous System. Upper, Middle, and Lower.

This system holds a very important position in the Northwest, not only from the vast area which it occupies, but also from the number, variety and beauty of its organic remains. The Cretaceous rocks as they appear in ascending the Missouri, have been separated into five divisions, which present well-marked lithological differences, and contain for the most part, distinct species of organic remains. From the following vertical section of the Cretaceous rocks of the Upper Missouri and the catalogue of Cretaceous fossils, it will be seen that formation No. 1 seems to constitute palæontologically an independent division, none of its organic remains ranging in other formations above or below. Nos. 2 and 3 appear to form one group, the *Ostrea congesta* and *Inoceramus problematicus* passing from one to the other. Divisions 4 and 5, which are the most fossiliferous formations on the Upper Missouri, contain many species in common, especially of the Cephalopoda, and therefore form a third group.

The Cretaceous system, as developed on the Upper Missouri, therefore forms lithologically five well-marked subdivisions, while palæontologically it admits of separation into but three independent groups. The age and geological position of Divisions 2, 3, 4 and 5 have been sufficiently attested by the numerous species of organic remains, which have been published from time to time by F. B. Meek and the writer. In regard to the age of No. 1, much doubt existed, until we had an opportunity to examine a fine series of Dicotyledonous leaves, discovered by the writer in this formation near Blackbird hill on the Missouri, while attached to Lieutenant Warren's party, in 1857. These leaves proved to us that the formation under consideration could not be older than Cretaceous. I will have occasion to allude to this point again in a subsequent part of this report.

VERTICAL SECTION OF THE CRETACEOUS FORMATIONS OF NEBRASKA TERRITORY, SO FAR AS DETERMINED.

Subdivisions.		Localities.	Estimated thickness.
No. 5.	Gray and yellowish arenaceous clays and sandstones at many localities, very ferruginous, with numerous concretions and a profusion of molluscous fossils, as *Belemnitella bulbosa, Nautilus Dekayi, Ammonites placenta, A. lobatus, Scaphites Conradi, Baculites ovatus, Ostrea subtrigonalis,* and a great number of marine mollusca.	All around the Black hills and head waters of the Shyenne, Moreau trading post, and under the Tertiary at Sage and Bear creeks; at the head of Teton river and at Long lake on the Missouri.	100 to 150 feet.
No. 4.	Bluish and dark gray plastic clays, containing *Nautilus Dekayi, Ammonites placenta, A. Halli, Baculites ovatus, B. compressus,* with numerous other marine mollusca,—remains of *Mosasaurus.* Along the Missouri river, below Fort Pierre, there is a local bed at the base of No. 4, composed of dark, very unctuous clay, containing much carbonaceous matter, with veins and seams of selenite, sulphuret of iron, and fish scales. 20 feet.	Around the Black hills; a great area around Fort Pierre, and along the Missouri. Under No. 5 at Sage and Bear creeks, along the Shyenne at Great Bend; on the Yellowstone and near Milk and Musselshell river.	350 feet.
No. 3. 100 feet.	Lead gray calcareous marl weathering above to a yellowish tint; scales and other remains of fishes; *Ostrea congesta,* passing downwards into	In the valley of Old Woman's creek; at Bear peak; around the Black hills and the sources of the Shyenne; in the bluffs along the Missouri, from Big Sioux river to Great Bend.	150 feet.
No. 3. 30 feet.	Light gray yellowish limestone, containing great numbers of *Inoceramus problematicus, Ostrea congesta,* and fish scales.		
No. 2.	Dark gray laminated clay, with teeth and scales of fishes, *Ammonites alpinianus, A. percarinatus, Serpula tenuicarinata, Inoceramus problematicus,* a small oyster like *O. congesta,* &c.	Old Woman's creek; Black hills; along the Missouri river from ten miles above James river to Big Sioux river.	200 feet.
No. 1.	Yellowish and reddish friable sandstone, with alternations of dark and whitish clays. Seams and beds of impure lignite, fossil wood, impressions of dicotyledonous leaves; *Solen, Pectunculus, Cyprina,* &c. Lower Cretaceous.	Old Woman's creek; Black hills; near the mouth of Big Sioux river; Lower Platte; near Judith river.	100 to 200 feet.

FORMATION NO. 1 OF THE VERTICAL SECTION.

In ascending the Missouri, No. 1 is first seen in the form of outliers overlapping the Carboniferous limestones near the mouth of the Platte. At De Soto it occupies the whole country, though concealed for the most part by grassy slopes. The first exposure along the Missouri occurs near Wood's bluffs, right bank, about one hundred and seventy miles above the mouth of the Platte. We have here a yellowish gray friable sandstone, twenty to thirty feet exposed, and overlying this, a recent deposit of water-worn pebbles, cemented by the hydrated oxide of iron, very deep rust color, 6 to 8 feet. Succeeding this in ascending order, 30 to 40 feet of yellow silicious marl. At Chalk bluffs about forty miles below the mouth of Big Sioux river, occurs the finest exposure of No. 1 along the Missouri.

	Feet.
1. Eight inches of earthy lignite, resting upon twelve inches of yellowish drab arenaceous clay, this in turn underlaid by eight inches of impure lignite.	
2. Ferruginous rather coarse-grained friable sandstone,	60 to 80
3. Yellow plastic or unctuous clay, toward the top becoming grayish blue, contains flat argillaceous iron concretions. Seen only during low water,	2

Overlying bed 1 are eight to twelve feet of ash-colored clay, which I suspect belongs to formation No. 2 of our general section. If so, it is an outlier, and the first indication of its appearance in ascending the river.

At this place I was unable to discover any well-preserved organic remains. In small seams of clay interstratified with the sandstone some traces of vegetable impressions were observed, and in some ferruginous concretionary sandstone some imperfect fragments of a plant resembling an *Equisetum*.

The next exposure of No. 1 is in a range of hills about two miles below the mouth of Big Sioux river, on the left bank of the Missouri. The sandstone at this point is quite variable in its character and structure. The whole forms a large concreted mass of rock of a dark dull reddish color, sometimes red or yellow, differing according to the amount of ferruginous matter contained in it. Only about twenty feet are exposed at this point. About fifteen feet above the base of the exposure, the rock has a compact silicious character, and from this portion is obtained the stone for building purposes. Near the top it becomes a friable coarse-grained ferruginous sandstone with dark purple nodules. These nodules possess merely a thin shell and are formed by concretionary action. A thin stratum occurs at this locality, filled with shells, of which casts only are obtained. The calcareous matter which formed the substance of the shells has been dissolved away, so

that most of their specific characters have been obliterated. The most abundant fossil is the *Pectunculus Siouxensis*, Hall and Meek. Great quantities of sulphuret of iron are found throughout the bed.

Passing up the Big Sioux river, about two miles above its mouth, the bed of lignite before mentioned is seen, two to two and a half feet in thickness, underlaid by sandstone, the same as seen at Wood's bluffs, Chalk bluff, &c. Here I found in considerable numbers a species of *Cytherea*. The lignite bed is exposed for several miles up the Big Sioux. Six miles above its mouth we have impure lignite, about twelve inches in thickness, underlaid by alternate layers of ferruginous sandstone, loose sand, yellow and ash-colored arenaceous clays, and fine whitish clay. The strata containing clay have quite distinct impressions of leaves, which belong to dicotyledonous trees. There were also some fine impressions in a dark gray though concretionary silicious rock. Two miles below the mouth of Iowa creek, on the Missouri, is a fine exposure of No. 1, in a bluff cut by the river; it contains at this locality large numbers of sandstone concretions, arranged in the coarse sand in horizontal strata. Great quantities of the sulphuret of iron are seen here in crystals or in large tabular masses, a fresh fracture of which has much the appearance of cast iron.

In the Platte valley, about four miles above the mouth of the Platte, No. 1 is first seen in a thin outlier, resting directly upon the limestones of the upper Coal measures. At the mouth of Elkhorn river, the limestones pass beneath the water-level, and No. 1 occupies the country until we reach a point about thirty miles above the mouth of Loup fork, where it is in turn concealed by the overlapping edges of No. 3, and the Pliocene and Miocene Tertiary beds of the Bad Lands of White river. Continuing a northwest course we do not meet again with No. 1 until we reach the valley of Old Woman's creek, a branch of the south fork of the Shyenne. It is here exposed over a small area by upheaval, and presents the same lithological characters as on the Missouri. Around the Black hills are a series of beds, supposed to belong to No. 1, exposed by the uplift of the mountains in the form of a belt or zone, which attain a thickness of 200 to 250 feet.

Returning again to the Missouri river, we take leave of the sandstone, which forms the type of our No. 1, near the mouth of Iowa creek; then succeed in regular order Cretaceous formations Nos. 2, 3, 4 and 5, and the Tertiary beds of the lignite basin. Near the mouth of Milk river, Cretaceous formation No. 4 rises to the surface, but 2 and 3 are wanting in this region. Near the mouth of Little Rocky Mountain creek, a bed of coarse-grained gray sandstone, variable in color and structure, rises above the water's edge from beneath the well-known Cretaceous formation No. 4 of section. In its lithological characters this bed of sandstone seems to resemble our No. 1, with which we have placed it provisionally, though we have no certain evidence that a single species of organic remains was common to both.

Although the group of beds observed along the Missouri river, near and below the mouth of the Judith, which we have referred provisionally to No. 1, has revealed many important facts to the geologist and palæontologist, yet the organic remains differ specifically from those of any other formation with which we are acquainted in the Northwest, so that we are unable to fix with certainty its exact position in the geological scale. We are confident, however, that the fossils for the most part belong to Cretaceous types, although some of the remains seem to point to the Jurassic. We have, therefore, regarded these beds as Lower Cretaceous, though we have no evidence as yet that they are on a parallel with No. 1 as revealed along the Missouri below the Big Sioux.

Having given the details of the geology of this group of beds in a memoir already published in the Transactions of this Society, I will not repeat them here in full, but in a subsequent chapter will present such additional information as I have been able to obtain. The following section will show approximately the lithological characters and order of succession of these deposits. The great disadvantage under which I labored and the hostile attitude of the Indians rendered it, much to my regret, impossible for me to examine this region over a large area to form a connected section of all the beds in detail. To attain so desirable a result will be the object of my exploration the coming season.

SECTION OF THE OLDER DEPOSITS AT THE MOUTH OF JUDITH RIVER, IN DESCENDING ORDER.

	Feet.
1. Yellowish and reddish rather coarse-grained sandstone, becoming deep red on exposure, containing *Inoceramus ventricosus, Mactra alta, Cardium speciosum*, &c. &c.,	20 to 25
2. Mixed pure and impure lignite, whole bed containing many crystals of selenite and a yellowish substance like sulphur. The masses of lignite when broken reveal in considerable quantities small reddish crystalline fragments of a substance having the taste and appearance of rosin,	6 to 8
3. Variable strata of drab clay and gray sand and sandstone. Upper part containing large numbers of *Ostrea glabra*. Near the middle there are gray or ash-colored clays with very hard bluish gray, granular, siliceous concretions containing *Hettangia Americana, Panopæa occidentalis, Mactra formosa*, &c. &c.,	80 to 100

A fine collection of fossils were obtained from these marine deposits, which will appear with the catalogue of Cretaceous species. Underlying these beds, where upheaved, were seen a series of variegated strata, clay, sands, &c., which undoubtedly are of Jurassic age.

FORMATION NO. 2 OF GENERAL SECTION.

This formation is first revealed in thin outliers below the mouth of Big Sioux river, and on the Big Sioux six miles above its mouth, it caps the bluffs, apparently mingling to some extent with the succeeding bed, and containing at this locality large numbers of *Inoceramus problematicus* and fragments of fishes. Near the mouth of Iowa creek and above, it shows

itself worthy of a separate position in the series. It is composed of a dark leaden gray plastic clay, containing few fossils, but great quantities of sulphate of lime in crystals, which assume a variety of beautiful forms. Its greatest thickness is seen about five miles below the mouth of James river.

Below the mouth of Vermilion river we have a perpendicular exposure showing Nos. 1, 2 and 3 in their order of superposition.

a. Gray and lightish yellow calcareous marl, containing in great numbers *Inoceramus problematicus* and comminuted fish remains. 40 feet. No. 3 of general section.

b. Dark plastic clay, with abundant fish remains in a fragmentary condition, also *Ammonites percarinatus*, *Serpula tenuicarinata*, and a species of *Ostrea* like *O. congesta*. 30 to 40 feet. No. 2 of general section.

c. Ferruginous sand-bed just above water's edge. At low water are seen large quantities of arenaceous concretions, with vegetable impressions and a species of *Pharella*. No. 1 of general section.

At this point *c* represents No. 1 as it dips beneath the water-level of the river; *a* No. 3 when it is seen for the first time largely developed and forming an independent bed.

About five miles above the mouth of Vermilion river, on the right side of the Missouri, No. 2 is finely exposed. It here contains several layers of a very hard, compact, dark gray, concretionary limestone. The fossils observed at this locality were an *Ammonite*, *Cytherea*, and quite numerous well-preserved teeth and other remains of fishes. At Dixon's bluffs I found *Serpula tenuicarinata*, an *Ostrea*, perhaps *O. congesta*, and large masses of the sulphuret of iron. Twelve miles above the mouth of James river, No. 2 is only about ten feet above the water's edge. At this locality overlying No. 2 is seen, quite well developed, formation No. 3, with *Ostrea congesta*, and above it, capping the hills, the first appearance of formation No. 4, in a thin outlier. No. 2 is exposed over a small area by the upheaval of the older rocks in the valley of Old Woman's creek, a tributary of the south fork of the Shyenne. It is also a very conspicuous bed around the Black hills, presenting the same lithological characters as on the Missouri, and containing a great abundance of fossils, *Ammonites*, *Scaphites*, *Cytherea*, *Ostrea*, &c., with large quantities of fish remains. It here attains a thickness of about 200 feet.

Formation No. 3 of General Section.

The geographical extension of this formation and its influence on the scenery render it one of the most interesting on the Upper Missouri. It is first seen in thin outliers at and a short distance below the mouth of the Big Sioux, and becomes quite conspicuous on the summits of the bluffs ten miles above Iowa creek. At Dorion's hills there is a fine section of this bed, about eighty feet exposed above the water's edge, containing its most abundant

and characteristic fossil, *Ostrea congesta*. From there it continues to be the predominant formation until we reach the foot of the Great Bend, when it passes by a gentle dip beneath the water-level of the Missouri. In many places, as opposite the mouth of Niobrara river, it is shown in the form of a long series of precipitous bluffs, giving a pleasing variety to the general monotony of the scenery. This is one of the principal characteristic external features of this formation. (See fig. 10.)

Fig. 10.

The upper portion of this rock is a yellowish and gray calcareous marl, very soft and yielding, so that it is easily cut up into numerous ravines by the temporary streams, and thus the bluffs along this part of the Missouri often present the appearance of a series of cones. At the mouth of the Niobrara the upper portion, about twenty feet in thickness, is much softer than that below, and is of a deep yellow color from the presence of ferruginous matter, and the lower portion is in the form of large square masses of gray limestone, set in the yellow material, which acts as a kind of mortar or cement. The vertical walls of the bluffs resemble very much the labors of some gigantic mason, so regular are they in their structure.

In the vicinity of Bijoux hills this formation seems to have been much depressed or to have suffered denudation prior to the deposition of No. 4, not more than twenty or thirty feet being exposed above the water-level. About twenty miles above this point a thickness of sixty or seventy feet is seen. Near the mouth of White river I found in this bed a large mass of calcareous spar, six feet in length and eighteen inches in thickness, also nodules of limestone formed of concentric coats, which is, I think, the same described by Nicollet as "cylindrical limestone resembling Arragonite."

Although so well developed and covering so wide an area on the Missouri, the middle and upper portions at least, of this rock can never be made useful for building purposes. Quite soft and friable in place, when detached it absorbs moisture rapidly and crumbles in pieces. Being a rich calcareous marl, it may be used at some future time as a fertilizer.

The fossils of this formation, although belonging to few species, so far as yet known, are numerous in individuals. A species of oyster (*O. congesta*) is found in great quantities throughout the bed, and in localities *Inoceramus problematicus* is abundant. Fish remains, though consisting mostly of scales and obscure fragments, are disseminated throughout the deposit, several species of which have already been identified and described by Dr. Leidy.

Near First Cedar island a very singular bed makes its appearance, superimposed on No. 3, which may be considered as probably forming an upper member of this formation. It extends up the Missouri about eighty miles to a point near the Great Bend; lithologically it is a dull black unctuous clay, entirely destitute of any grit, and does not effervesce with an acid. It contains some carbonaceous matter, great quantities of selenite in crystals, in thin laminæ, and in thick rhomboidal masses. In a number of localities I noticed fish remains, but no other organic bodies. In several places the carbonaceous matter of this bed has been ignited, producing heat enough to give to the surrounding strata a brick-red color, and the slabs of clays thus affected by the heat give a ringing sound under a blow of the hammer. Ten miles below the mouth of White river this rock has been subjected to a considerable degree of heat for several yards, so that the surrounding strata present an appearance similar to those which have been affected by the burning of the lignite beds on the Yellowstone. The superincumbent beds have from this cause fallen in some instances fifteen or twenty feet below their original position. Mr. Nicollet, in his interesting report on this region, examined these phenomena with great care, and I cannot do better than to quote his explanation of them: "These pseudo-volcanic phenomena may be compared with those described as occurring in other portions of the globe under the name of *terrains ardens*, although they are not here accompanied by the emission of flames. They are evidently due to the decomposition, by the percolation of atmospheric waters to them, of beds of pyrites, which, reacting on the combustible materials, such as lignites and other substances of a vegetable nature in their vicinity, give rise to spontaneous combustion,

while further reactions—well understood by the chemist—upon the lime contained in the clay bed, produce the masses and crystals of selenite that are observed in the lower portion of this interesting deposit. This is the theory which, with some little confidence, we have formed of these pseudo-volcanoes."

About two miles above the mouth of White river, the burnt appearance is again visible in this bed. Near this locality there is a seam formed of an accumulation of saline matter, a yellow substance like sulphur, selenite, and the hydrated peroxide of iron, three feet in thickness, the whole presenting a variety of colors. Large masses have fallen down at the base of the bluffs.*

Formation No. 4 of General Section.

This formation is geologically the most important one in the Cretaceous system of the Northwest, not only from its thickness and its geographical distribution, but also on account of its influence on the agricultural capacities of the country. It is only second in interest to the succeeding bed in number, beauty, and variety of its organic remains. Commencing about ten miles above the mouth of James river, where it is seen only in thin outliers, capping the distant hills and bluffs, it continues, gradually assuming a greater thickness as we ascend the Missouri, until we reach the Great Bend, where it monopolizes the whole region, giving to the country underlaid by it a most gloomy and sterile aspect. At the Great Bend it attains a thickness of two hundred feet, and continues to occupy the country bordering the Missouri to the mouth of Grand river, where, in consequence of the northwesterly dip of the strata, it passes gradually beneath the water-level of the river.

The general lithological character of the formation, the boundaries of which have been described above, is a dark ash-colored clay, varying, however, in color and structure in different localities. From the Great Bend to the mouth of the Shyenne river, it shows but little of its shaly character. Its general stratification is horizontal, but the layers are broken into numerous irregular fragments. Not unfrequently the layers of clay have a seam of gray sand between them. This bed contains great quantities of a whitish saline substance,† a yellow material like sulphur, and an abundance of ferruginous matter, which

* Since this report was written I think I have obtained good evidence that the bituminous bed forms the base of No. 4 instead of the top of No. 3. In several places near Bijoux hills the surface of the marly portion of No. 3 exhibits the appearance of erosion to a considerable extent prior to the deposition of the bituminous clays.

† This white substance is found disseminated to a greater or less extent throughout all the Cretaceous and Tertiary beds of the Northwest. It effloresces on the surface of the hills or bluffs, giving them a snow-white appearance. It impregnates the water that issues from or flows over these beds, rendering it exceedingly disagreeable in its taste and purgative in its effects. It sometimes covers an area of considerable extent where the water has dried away in the autumn from a depression in the surface. Near the mountains it is sometimes seen covering the

often discolors the banks of the river. At the Great Bend, a local variation occurs in No. 4, near the summit of the hills. It is a seam two to six feet in thickness, of very fine light buff-colored clay, containing no fossils, and is visible only for a few miles.

After passing the mouth of Great Shyenne river, a slight change occurs in the lithological character of the upper portion of this formation, thence to the Moreau river it exhibits a laminated or shaly structure, and a dark silvery or leaden gray color. These characters are seen on the Moreau river eighty miles above its mouth, also at Sage creek near the Bad Lands.

After dipping beneath the water-level of the Missouri, between Grand and Cannon-ball rivers, this formation again rises to the surface near Quaking Asp river, in longitude 109°, by a reversed inclination of the strata. Its first appearance is in a little tributary of the Missouri, and is seen only for about a hundred yards, yet presenting its peculiar characters.

Thirty miles below the mouth of Milk river it is revealed by the reverse dip above referred to, for the first time along the Missouri, after leaving a point near Cannon-ball river, under the northern portion of the great lignite Tertiary basin. It here has a thickness exposed of forty to sixty feet, presenting the same general character as at the Great Bend. It contains numerous flat masses of rock arranged in horizontal layers in the exposure, with a few fossils. Just below the mouth of Porcupine river, there is a high range of bluffs, presenting a good exposure of this bed, containing fine argillo-calcareous concretions, fully laden with organic remains of the genera *Ammonites*, *Baculites*, *Inoceramus*, &c. I notice that the Inocerami seem to have existed in vast numbers to the exclusion of other forms. No. 4 continues to attain a greater thickness as we ascend the Missouri, until we come in the vicinity of Round butte, where we find it to be two hundred to two hundred and fifty feet. Here it is overlaid by a ferruginous sand-bed, composed in part of immense ledges of concretionary sandstone. No fossils were observed in it, yet I think it is the upper portion of No. 5, or a transition bed between the Cretaceous and Tertiary. Below the mouth of Mussel-shell river, as well as above, indeed wherever this formation is exposed in this region, its peculiar fossils are found in great abundance. Near the mouth of Mussel-shell river, I found an *Inoceramus* fifteen inches long and

ground to the depth of five or six inches, and is used by the traders in their culinary operations as a substitute for saleratus. Dr. Hayes of Boston made an analysis of an impure specimen obtained near Fort Benton, in Gov. Stevens's expedition, with the following result:

100 parts.
- Moisture=3.20.
- Sulphate of lime=5.60.
- Sulphate of alumina and iron=3.25.
- Sulphate of soda=43.40.
- Insoluble sand=44.00.

twelve broad, *Ammonites* eighteen inches to two feet in diameter, also the vertebræ of a huge Cetacean. Near Little Rocky Mountain creek, No. 4 begins to rise toward the summit of the hills, and about fifty miles below the mouth of the Judith it caps the bluffs, still containing its characteristic fossils. It continues to be seen in thin outliers to the vicinity of Fort Benton, perhaps even farther, but its limits in that direction have not yet been ascertained.

On the Yellowstone river I observed this formation in but one locality, about eighty miles above the mouth of that river. The Cretaceous strata here have an extent of only about eight miles, and are exposed only along the banks cut by the river, yet in that space they reveal the remains of marine mollusca in a profusion which I have seen in no other locality. In ascending the river its first appearance is a lightish blue clay, containing a few concretions. At its best exposure above the water's edge, we have the following section:

a. Dark ash-colored clay, upper part of a bluish cast, slightly indurated, filled with concretions fully charged with shells. The fossils are so abundant in the concretions that they form large masses of shell conglomerate, cemented with a fine blue calcareous clay, exceedingly hard and breaking with an irregular fracture. This is probably but an extension in a northwest direction of the same shell zone seen at Moreau and Grand rivers, forks of Shyenne, Sage creek, &c. 20 feet.

b. A very dark indurated clay, presents similar characters to its equivalent at Great Bend, and contains fewer fossils than the bed above.

The fossils of bed *a* indicate a blending of formations 4 and 5. The whole thickness of Cretaceous rocks exposed on the Yellowstone at this locality is not more than twenty-five feet, and the distant hills on either side are composed of Tertiary beds.

We will now return to White or Smoking Earth river below Fort Pierre, and trace this formation into the interior of that interesting region. Passing up the valley of White river, we find it occupying the country bordering upon that stream for about fifty miles above its mouth. Near this point outliers of the White river Tertiary basin begin to cover the highland, and No. 4 is seen along the river for about twenty miles farther, when it is concealed by Tertiary strata. The intervening country east and northeast of the Bad Lands to the Shyenne river, a distance of one hundred and fifty miles, is for the most part underlaid by this bed, except an extension of Fox ridge, to the sources of the Teton river, which is composed of formation No. 5 of the vertical section. The extensive area drained by the Shyenne river is composed of No. 4, excepting the sources of a few of its tributaries. Sage and Bear creeks take their rise in the White river Tertiary basin, but flow mostly through this formation, revealing large quantities of Cretaceous fossils. A few small tributaries have their origin in the Fox ridge, and Cherry river has its source in the Lignite Tertiary basin, near the head waters of the Little Missouri.

In summing up the extent of country underlaid by this great formation, we find that south of the Lignite basin, it occupies an area of two hundred miles in length and one hundred in breadth, or twenty thousand square miles. North of the Great Lignite basin, commencing at its first appearance near Milk river, we find it covering an area of two hundred miles in length and sixty in breadth, or about twelve thousand square miles. I have been thus particular in estimating its approximate limits and extent of surface, on account of its influence on the future destiny of that region. Wherever this deposit prevails it renders the country more completely sterile than any other geological formation I have seen in the Northwest. We see from the above estimate that it renders barren over thirty thousand square miles of the valley of the Missouri.

The organic remains of this formation are too numerous to mention in detail. The lower and upper members appear to be very fossiliferous, while the intervening portion, of considerable thickness, contains only a few imperfect specimens of *Cephalopoda* and the bones of *Mosasaurus Missouriensis*. The strata dip toward the northwest below Fort Clark. At the Lower Bend, which seems to be formed of the lower portion of No. 4, contains its peculiar fossils in great numbers. They are found in the loose clay or in tough argillo-calcareous concretions, and many fine specimens are found along the shore of the river at low water. We then have an interval of about two hundred and fifty miles, to a point near the mouth of Grand river, wholly occupied by No. 4, in which are only the few imperfect specimens of fossils before mentioned. Near the mouth of Grand river the upper members yield an abundance of organic remains, many of which are specifically identical with those occurring at the Great Bend, with many new and interesting forms. At Sage creek and along the Shyenne river above its forks are noted localities for fossils. *Baculites* are found in great perfection and beauty, *Ammonites placenta* occur three feet in diameter, and a peculiar fossil, having a columnar structure like some forms of coral, *Caprinella coraloidea* (Hall and Meek), which is known only in this region. On the Yellowstone many new forms are found, mostly belonging to small *Acephala* and *Gasteropoda*, and the only species of *Echinoderm* yet known in the Cretaceous rocks of the Northwest occurs at this locality. Above Milk river this formation is filled with fossils, revealing, in addition to many of the forms occurring in the localities already mentioned, a large number of new species, as *Gervilia subtortuosa*, *Ostrea patina*, *Ammonites Halli*, &c. For the complete list of the fossils occurring in each formation the reader is referred to the catalogue at the close of the remarks on the Cretaceous formations.

Formation No. 5 of Vertical Section.

This very interesting bed, though differing lithologically from the preceding one, contains many of the same species of fossils. It is worthy, however, of a distinct position in

the series, not only from its extent, thickness, and difference of composition, but also from the more favorable influence that it exerts upon the country underlaid by it. In ascending the Missouri river it first makes its appearance near the mouth of Grand river, about one hundred and fifty miles above Fort Pierre. Near Butte aux Gres it becomes quite conspicuous, acquiring a thickness of eighty or one hundred feet, and containing great quantities of organic remains. Here it forms an extension of what is called Fox ridge, a series of high hills, having a northeast and southwest course, crossing the Missouri river into Minnesota at this point. Its northeastern limits I have not ascertained. In its southwestern extension it continues for a considerable distance nearly parallel with the Missouri, crosses the Moreau river about thirty miles above its mouth, then forms a high dividing ridge between the Moreau and Shyenne rivers, at which locality it first took its name. Continuing thence its southwesterly course, it crosses the Shyenne, and is seen again in its full thickness at the heads of Opening creek and Teton river, forming a high ridge, from which tributaries of the Shyenne and Teton take their rise. The little streams flowing into the Shyenne have a northwesterly course, while those emptying into the Teton take a southeasterly direction. We thus find that this bed underlies an area of about two hundred miles in length and fifty miles in breadth, or about ten thousand square miles.

The general character of formation No. 5 is a yellow arenaceous and argillaceous grit, containing a great amount of ferruginous matter and in localities a profusion of organic remains. It forms a much more fertile soil, sustains a more healthy and luxuriant vegetation than formation No. 4, and abounds in springs of good water.

Like No. 4 this formation yields in the greatest abundance quite perfect and well-preserved organic remains. Many of the species approximate so closely to Tertiary forms that, did we not everywhere find them associated with *Ammonites*, *Scaphites*, *Baculites*, and other genera which are not known to have existed later than the Cretaceous epoch, we should at once pronounce the formation in which they occur to belong to the Tertiary period. Fossils are found throughout this formation to a greater or less extent, and the species are too numerous to mention any but the most characteristic and abundant ones. The greatest proportion of the species are restricted to this bed; and those which are common to it and formation No. 4 are chiefly *Cephalopoda*, which everywhere have an extensive vertical as well as geographical range. At Butte aux Gres on the Missouri we find great quantities of fossils inclosed in tough ferruginous silicious concretions, as *Scaphites nodosus*, *S. Conradi*, *Nautilus Dekayi*, a most abundant bivalve, *Mactra Warrenana*, &c. Along the Moreau river and on Fox hills, *Busycon Bairdi*, *Cucullæa Nebrascensis*, *C. Shumardi*, *Fusus Haydeni*, occur in great numbers. At the head of Teton river, where this formation attains a great thickness and presents its usual lithological characters, very few fossils are found, a single fish-tooth, a small undescribed mollusc, and a few impressions

on sandstone, supposed to be trails of Planarian worms, are all the organic remains yet known from this locality. At Sage creek and on the Yellowstone, where the Cretaceous rocks are exposed, the fossils indicate a blending of Nos. 4 and 5. Wherever No. 5 is exposed in the vicinity of Tertiary beds the strata of both the White river and lignite basins repose directly upon it. It covers a large area around the Black hills, but its entire limits are not yet known.

The following catalogue of Cretaceous fossils taken from a paper published by Mr. Meek and myself in the Proceed. Acad. Nat. Sci. Phila. Oct. 1860, is so arranged as to show the stratigraphical position as well as vertical range of each species, and the reader is referred to the vertical section of the Cretaceous rocks of the Northwest.

"Of the 194 Cretaceous species and varieties enumerated in the following catalogue, seven are common to the Nebraska and New Jersey beds, viz.: *Nautilus Dekayi*, *Ammonites placenta*, *A. complexus*, *A. lobatus*, *Scaphites Conradi*, *Baculites ovatus*, and *Gryphæa vesicularis?*; and the following five species are probably common to Nebraska and foreign localities, viz.: *Nautilus Dekayi*, *Inoceramus problematicus*, *Gryphæa vesicularis*, *Cucullæa fibrosa*, and *Microbacia coranula*."*

CRETACEOUS SPECIES.	Formations in ascending order.				
	1	2	3	4	5
ARTICULATA.					
ANNELIDA.					
TUBICOLA.					
Serpula? tenuicarinata, M. & H. May 1857, Pr. Acad. Nat. Sci. Phil. 134,		*			
MOLLUSCA.					
CEPHALOPODA.					
TEUTHIDÆ.					
Phylloteuthis subovatus, M. & H. May 1860, Pr. Acad. Nat. Sci. Phil. 175, .					*
BELEMNITIDÆ.					
Belemnitella bulbosa, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 70, .					*
NAUTILIDÆ.					
Nautilus Dekayi, Morton, 1834, Synop. Or. Rem. 33, pl. 8, fig. 4, and pl. 13, fig. 4, ...				*	*
AMMONITIDÆ.					
Ammonites percarinatus, Hall & Meek, 1854, Mem. Am. Acad. Arts and Sci. Boston, v. N. S. pl. iv, fig. 2, ...				*	
Ammonites vermilionensis, M. & H. May 1860, Pr. Acad. Nat. Sci. Phil. 177, ...		*			
Ammonites complexus, Hall & Meek, 1854, Mem. Am. Arts and Sci. Boston, v, N. S. 394, pl. iv, fig. 1, ...				*	

* See remarks accompanying the paper from which this Catalogue is taken.

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
Ammonites Halli, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 70, . .				*	
Ammonites placenta, Dekay, 1827, New York Lyc. Nat. ii, pl. 5, fig. 2. (Non *A. placenta* Leckenby, 1858.)				*	*
Ammonites placenta, var. *intercalaris*, M. & H. Pr. Acad. Nat. Sci. Phil. 177,				*	*
Ammonites lobatus, Tuomey, 1854, Pr. Acad. Nat. Sci. Phil. vii, 168, . .					*
Ammonites lenticularis, Owen, 1852. Report Iowa, Wiscon. and Min. tab. 8, fig. 5. (Non *A. lenticularis* of Phillips, 1825.)					
Scaphites Mandanensis, Morton sp.					*
Ammonites Mandanensis, Morton, 1841, Jour. Acad. Nat. Sci. Phil. viii, 208, pl. 10, fig. 2.					
Scaphites Mandanensis, Meek & Hayden, Nov. 1836, Pr. Acad. Nat. Sci. Phil. 281.					
Scaphites abyssinus, Morton sp.					*
Scaphites Mandanensis? Meek & Hayden, Nov. 1836, Pr. Acad. Nat. Sci. Phil. 281.					
Scaphites Cheyennensis, Owen sp.					*
Ammonites Nebrascensis, Owen, 1852. Report Wisc. Iowa and Min. pl. vii, fig. 2.					
Ammonites Cheyennensis, Owen, " " " pl. viii, fig. 2.					
Ammonites Moreauensis, Owen, " " " pl. viii, fig. 2.					
Scaphites Conradi (pars) Meek & Hayden, Nov. 1856, Pr. Acad. Nat. Sci. Phil. 281.					
Scaphites Conradi, Morton sp.					*
Ammonites Conradi, Morton, 1834, Synop. Org. Rem. 39, pl. xvi, fig. 1, 2, 3.					
Ammonites Danæ, d'Orbigny, 1850, Prodrom. de Palæont. ii, 213.					
Scaphites Conradi, d'Orbigny, 1850, " " 214.					
Scaphites Conradi, var. *gulosus*, Morton, sp., ...					*
Ammonites var. *gulosus*, Morton, 1854, Synopsis Org. Rem. 39, pl. xvi, fig. 2.					
Scaphites Nicoletii, Morton sp.				*	*
Ammonites Nicoletii, Morton, 1841, Jour. Ac. Nat. Sci. Phil. viii, pl. x, fig. 3.					
Scaphites comprimus (?), Owen, Report Wiscon. Iowa and Min. tab. vii, fig. 4.					
Scaphites Nicoletii, Meek & Hayden, Nov. 1856, Proc. Acad. Nat. Sci. Phil. 281.					
Scaphites (Ammonites?) nodosus, Owen, 1852, Report Iowa, Wiscon. and Min. 581, tab. viii, fig. 4, ...				*	
Scaphites nodosus var. plenus, M. & H. May 1860, Pr. Acad. Nat. Sci. Phil. 177, ...				*	
Scaphites nodosus var. brevis, Meek & Hayden (MSS.)				*	
Scaphites nodosus var. quadrangulus, Meek & Hayden (MSS.) . .				*	
Scaphites nodosus var. exilis, Meek & Hayden, ...				*	
Scaphites larvæformis, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 58, .		*			
Scaphites Warreni, M. & H. May 1860, Pr. Acad. Nat. Sci. Phil. 177, . .		*			
Ancyloceras? uncus, Meek & Hayden, ...				*	
Ancyloceras (*Hamites*) *uncus*, M. & H. Pr. Acad. Nat. Sci. Phil. 56.					
Helicoceras Mortoni, Hall & Meek sp.				*	
Hamites Mortoni, Hall & Meek, 1854, Mem. Am. Acad. Arts and Sci. v. N. S. pl. iv, fig. 3.					

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
Helicoceras tenuicostatum, M. & H. March 1858, Pr. Acad. Nat. Sci. Phil. 56.					
Helicoceras cochleatum, Meek and Hayden, ...				*	
Turrilites (Helicoceras) cochleatus, M. & H. March 1858, Pr. Acad. Nat. Sci. Phil. 55.					
Helicoceras cochleatum, M. & H. May 1860, Pr. Acad. Nat. Sci. Phil. 185.					
Helicoceras Nebrascense, Meek & Hayden, ...				*	
Ancyloceras? Nebrascensis, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 71.					
Turrilites Nebrascensis, M. & H. Nov. 1856, " " 280.					
Helicoceras tortum, M. & H. March 1858, " " 54, .				*	
Helicoceras Cheyennense, Meek & Hayden, ...				*	
Ancyloceras? Cheyennense, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 71.					
Turrilites Cheyennensis, M. & H. Nov. 1856, " " 280.					
Helicoceras angulatum, M. & H. May 1860, " " 176, .				*	
Helicoceras umbilicatum, Meek & Hayden.					
Turrilites? umbilicatus, M & H. March 1858, Pr. Acad. Nat. Sci. Phil. 56.					
Helicoceras umbilicatum, M. & H. May 1860, " " 185, .				*	
Ptychoceras Mortoni, M. & H. May 1857, " " 134, .				*	
Baculites ovatus, Say, Jour. Acad. Nat. Sci. Phil. vi, pl. v, fig. 5, 6, . .				*	*
Baculites grandis, Hall & Meek, 1854, Mem. Am. Acad. Arts and Sci. Boston, v, N. S. 402, ...					*
Baculites asperoides, Meek & Hayden. (MSS.)					
Baculites compressus, Say, Am. Jour. Sci. ii, 41, ...				*	
Aptychus Cheyennensis, Meek & Hayden. (MSS.)					*
Aptychus fragilis, Meek & Hayden. (MSS.)				*	
GASTEROPODA.					
MURICIDÆ.					
Fusus (Neptunea) Dakotensis, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 65.					*
Fusus (Pyrifusus?) Newberryi, M. & H. March 1857, Pr. Acad. Nat. Sci. Phil. 66, ...					*
Fusus subturritus, M. & H. May 1857, Pr. Acad. Nat. Sci. Phil. 139, . .				*	
Fusus intertextus, M. & H. " " " 139, . .				*	*
Fusus? flexicostatus, M. & H. March 1856, " " 66, . .					*
Fusus Vaughani, M. & H. May 1857, " " 139, . .					*
Fusus vinculum, Hall & Meek sp., ...				*	
Buccinum? vinculum, H. & M. Mem. Acad. Sci. and Arts, Boston, v, N. S. pl. iii, fig. 5.					
Fusus vinculum, M. & H. May 1860, Pr. Acad. Nat. Sci. Phil. 183.					
Fusus Scarboroughi, M. & H. May 1857, Pr. Acad. Nat. Sci. Phil. 139, .					*
Fusus Culbertsoni, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 66, .					*
Fusus Haydeni, Evans & Shumard, 1857, Trans. Acad. Sci. St. Louis, 41.					
Fusus Galpinanus, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 65, .					*

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
Fusus? tenuilineatus, Hall & Meek, 1854, Mem. Am. Acad. Arts and Sci. Boston, v. N. S. 394, pl. iii, fig. 9, ...				*	
Busycon Bairdi, Meek & Hayden, ...					*
Pyrula Bairdi, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 66.					
Busycon Bairdi, M. & H. June, 1856, " " 126.					
TURRITIDÆ.					
Turris minor, Evans & Shumard sp.					*
Pleurotoma minor, E. & S. 1857, Trans. Acad. Sci. St. Louis, i, 41.					
Turris contortus, Meek & Hayden, ...					*
Fusus contortus, M. & H. March 1856, Pr. Acad. Nat. Sci Phil. 65.					
Pleurotoma contorta, M. & H. May 1860, " " 183.					
BUCCINIDÆ.					
Buccinum constrictum, Hall & Meek sp.				*	
Fusus constrictum, H. & M. Mem. Am. Acad. Arts and Sci. Boston, v, 391, pl. iii, fig. 7.					
Pseudobuccinum Nebrascense, Meek & Hayden, ...					*
Buccinum? Nebrascense, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 67.					
Pseudobuccinum Nebrascense, M. & H. May 1857, " " 140.					
FASCIOLARIADÆ.					
Fasciolaria? cretacea, M. & H. March 1856, Pr. Acad. Nat. Sci. Phil. 66, .					*
Fasciolaria buccinoides, M. & H. " " " 67, .					*
NATICIDÆ.					
Natica (Lunatia) subcrassa, M. & H. April 1856, Pr. Ac. Nat. Sci. Phil. 87,					*
Natica (Lunatia) Moreauensis, M. & H. Mar. 1856, " " 64,					*
Natica (Lunatia) occidentalis, M. & H. " " " 64,					*
Amauropsis paludinæformis, Hall & Meek, sp.				*	
Natica paludinæformis, H. & M. 1854, Mem. Am. Sci. and Arts, Boston, v, 389, pl. iii, fig. 3.					
Amauropsis paludinæformis, M. & H. May 1860, Pr. Acad. Nat. Sci, Phil. 185.					
SCALIDÆ.					
Scala (Acirsa) cerithiformis, Meek and Hayden, ...					*
Scalaria cerithiformis, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 63.					
Turbonilla cerithiformis, M. & H. May 1860, " " 185.					
CERITHIOPSIDÆ.					
Cerithiopsis Moreauensis, Meek & Hayden, ...					*
Turritella Moreauensis, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 70.					
Cerithiopsis Moreauensis, M. & H. May 1860, " " 185.					
STROMBIDÆ.					
Gladius? Cheyennensis, Meek & Hayden, ...				*	
Rostellaria fusiformis, H. & M. 1854, Mem. Acad. Sci. and Arts, Boston, v, N. S. pl. iii, fig. 10.					
(Non *R. fusiformis*, Pictet and Roux, 1848.)					

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
APORRHAIDÆ.					
Aporrhais Americana, Evans & Shumard sp. . . . . *Rostellaria Americana*, E. & S. 1857, Trans. St. Louis Acad. Sci. i, 42.				*	
Aporrhais Nebrascensis, Evans & Shumard, sp. . . . . *Rostellaria Nebrascensis*, E. & S. Aug. 1854, Pr. Acad. Nat. Sci. Phila. 164.				*	
Aporrhais sublevata, M. & H. May 1860, " " 178, .				*	
Aporrhais biangulata, Meek & Hayden, ... *Rostellaria biangulata*, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 65. *Aporrhais biangulata*, M. & H. May 1860, " " 185.				*	
Aporrhais parva, M. & H. " " " 178, .				*	
LITORINIDÆ.					
Fossar? Nebrascensis, Meek & Hayden, ... *Natica ambigua*, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 66. (Non *Fossar ambiguus*, Lin. sp.)					*
NERITOPSIDÆ.					
Neritopsis? Tuomeyana, Meek & Hayden, ... *Natica Tuomeyana*, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 270.	*				
TROCHIDÆ.					
Margarita Nebrascensis, Meek & Hayden, ... *Turbo Nebrascensis*, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 64. *Margarita Nebrascensis*, M. & H. May 1860, " " 185.				*	
*Margaritella flexistriata, Evans & Shumard, sp. . . . . *Solarium flexistriatum*, E. & S. Aug. 1854, Pr. Acad. Nat. Sci. Phila. 163.				*	
DENTALIADÆ.					
Dentalium gracile, H. & M. 1854, Mem. Am. Acad. Arts. and Sci. Boston, v, N. S. pl. iii, fig. 11, ...				*	
Dentalium paupereculum, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 178,					*
TECTURIDÆ.					
Tectura occidentalis, Hall & Meek, sp. . . . . *Capulus occidentalis*, H. & M. 1854, Mem. Am. Acad. Sci. and Arts, Boston, v, N. S. p. 385, fig. 13.				*	
Tectura? parva, Meek & Hayden. (MS.)				*	
Tectura? papillata, Meek & Hayden, ... *Capulus fragilis*, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 68. (Non *Tectura fragilis*, Gray & Gamard.)					*
Anisomyon borealis, Morton sp: . . . . . *Hipponyx borealis*, Morton, 1842, Jour. Ac. Nat. Sci. Phila. viii, pl. xi, fig. 6. *Helcion carinatus*, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 68. *Anisomyon borealis*, M. & H. Jan. 1860, Am. Jour. Sci. xxviii, 2d ser. 35.				*	
Anisomyon Shumardi, Meek & Hayden. (MS.)				*	
Anisomyon patelliformis, Meek & Hayden, ... *Helcion patelliformis*, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 68.				*	

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
Anisomyon patelliformis, M. & H. Jan. 1860, Am. Jour. Sci. xxviii, 2d ser. 35, pl. i.					
Anisomyon subovatus, Meek & Hayden, ...				*	
Helcion subovatus, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 68.					
Anisomyon subovatus, M. & H. Jan. 1860, Am. Jour. Sci. xxviii, 2d ser. 35.					
Anisomyon alveolatus, Meek & Hayden, ...				*	
Helcion alveolatus, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 68.					
Anisomyon alveolatus, M. & H. Jan. 1860, Am. Jour. Sci. xxxviii, 2d ser. 35.					
Anisomyon sexsulcatus, Meek & Hayden, ...				*	
Helcion sexsulcatus, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 68.					
Anisomyon sexsulcatus, M. & H. Jan. 1860, Am. Jour. Sci. xxxviii, 2d ser. 35.					
SOLIDULIDÆ.					
Solidula subelliptica, Meek & Hayden, ...				*	
Acteon subelliptica, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 63.					
Solidulus (Acteonina?) subelliptica, M. & H. May 1860, " 185.					
Solidula (Acteonina?) attenuata, Meek & Hayden, ...				*	
Acteon (solidulus) attenuata, M. & H. Mar. 1858, Pr. Acad. Nat. Sci. Phila. 54.					
Solidulus attenuatus, M. & H. May 1860, " " 185.					
Cinulia concinna, Hall & Meek, sp.					*
Acteon concinna, H. & M. 1854, Mem. Am. Acad. Arts and Sci. Boston, v, N. S. pl. iii, fig. 4.					
Avellana subglobosa, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 64.					
BULLIDÆ.					
Bulla occidentalis, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 69, .				*	
Bulla minor, M. & H. " " " 69, .					*
Bulla volvaria, M. & H. " " " 69, .					*
Bulla speciosa, Meek & Hayden, ...				*	
Bulla subcylindrica, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 270. (Non *B. subcylindrica*, d'Orbigny, 1847.)					
Bulla speciosa, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 185.					
CYLICHNIDÆ.					
Cylichna scitula, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 178, . .					*
CONCHIFERA.					
PHOLADIDÆ.					
Pholas? Stimpsoni, Meek & Hayden, ...				*	
Xylophaga Stimpsoni, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 141.					
Pholas (Martesia) cuneata, M. & H. Mar. 1858, " " 53, .				*	
Xylophaga elegantula, M. & H. May 1857, " " 141, .				*	
Teredo selliformis, M. & H. May 1860, " " 178, .					*
Teredo globosa, M. & H. March 1858, " " 53, .					*
SAXICAVIDÆ.					
Panopæa occidentalis, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 270, .	*				

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
SOLENIDÆ.					
Pharella? Dakotensis, Meek & Hayden, ... *Solen? Dakotensis*, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 242.	*				
CORBULIDÆ.					
Corbula crassimarginata, Meek & Hayden. (MSS.)				*	
Corbula inornata, M. & H. March 1858, Pr. Acad. Nat. Sci. Phila. 52.					
Corbulamella gregarea, Meek & Hayden, ... *Corbula? gregarea*, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 84. *Corbulamella gregarea*, M. & H. May 1857, " " 143.				*	*
Neæra ventricosa, Meek & Hayden, ... *Corbula ventricosa*, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 83. *Neæra ventricosa*, M. & H. May 1860, " " 183.					*
Neæra Moreauensis, Meek & Hayden, ... *Corbula Moreauensis*, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 83. *Neæra Moreauensis*, M. & H. May 1860, " " 185.					*
ANATINIDÆ.					
Thracia subtortuosa, Meek & Hayden, ... *Tellina subtortuosa*, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 272.	*				
Thracia gracilis, Meek & Hayden, ... *Tellina gracilis*, M. & H. April 1855, Pr. Acad. Nat. Sci. Phila. 82. *Thracia? gracilis*, M. & H. Nov. 1856, " " 284.	*				
Thracia Prouti, Meek & Hayden, ... *Tellina Prouti*, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 85.	*				
Pholadomya (?) fibrosa, Meek & Hayden, ... *Avicula (?) fibrosa*, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 86. *Pholadomya fibrosa*, M. & H. Nov. 1856, " " 283.				*	
Pholadomya subventricosa, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 142, ...	*				
Pholadomya undata, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 81, .	*				
MACTRIDÆ.					
Mactra (Trigonella?) formosa, Meek & Hayden, Nov. 1856, Pr. Acad. Nat. Sci. Phila. 271, ...	*				
Mactra (Trigonella?) alta, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 271,	*				
Mactra (Trigonella?) Siouxensis, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 179, ...	*				
Mactra (Trigonella?) Warrenana, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 281, ...					*
Mactra (Trigonella?) gracilis, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 179, ...				*	*
TELLINIDÆ.					
Tellina equilateralis, Meek & Hayden, April 1856, Pr. Acad. Nat. Sci. Phila. 82, ...				*	
Tellina scitula, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 82, . .					*

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
Tellina (?) formosa, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 179, .				*	
Tellina (?) subelliptica, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 83,					*
Tellina (?) Cheyennensis, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 82,				*	
VENERIDÆ.					
Venus circularis, Meek & Hayden, Nov. 1856, Pr. Acad. Nat. Sci. Phila. 272,				*	
Meretrix tenuis, Hall & Meek, sp., ...		*			
Cytherea tenuis, Hall & Meek, 1854, Mem. Am. Acad. Arts and Sci. Boston, v, N. S. 383, pl. i, fig. 8.					
Meretrix tenuis, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 185.					
Meretrix pellucida, Meek & Hayden, ...				*	
Cytherea pellucida, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 272.					
Meretrix pellucida, M. & H. May 1860, " " 185.					
Meretrix Deweyi, Meek & Hayden, ...					*
Cytherea Deweyi, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 83.					
Meretrix Deweyi, M. & H. May 1860, " " 185.					
Meretrix Owenana, Meek & Hayden, ...	*				
Cytherea Owenana, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 273.					
Meretrix Owenana, M. & H. May 1860, " " 185.					
Meretrix orbiculata, Hall & Meek, sp., ...		*			
Cytherea orbiculata, Hall & Meek, 1854, Mem. Acad. Arts and Sci. Boston, v, N. S. pl. i, fig. 7.					
Meretrix orbiculata, Meek & Hayden, May 1860, Pr. Acad. Nat. Sci. Phila. 185.					
CYPRINIDÆ.					
Cyprina arenarea, Meek & Hayden, May 1857, Pr. Acad. Nat. Sci. Phila. 143,	*				
Cyprina subtumida, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 144, .				*	*
Cyprina humilis, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 179, . .					*
Cyprina ovata, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 144, . . .					*
CARDIDÆ.					
Bucardia? Moreauensis, Meek & Hayden, ...					*
Cyprina cordata, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 143. (Non. *B. cordata*, sp. Buckm.)					
Tancredia Americana, Meek & Hayden, ...	*				
Hettangia Americana, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 274.					
Tancredia Americana, M. & H. May 1860, " " " 185.					
Cardium speciosum, Meek & Hayden, Nov. 1856, Pr. Acad. Nat. Sci. Phila. 274, ...	*				
Cardium rarum, Evans & Shumard, Trans. Acad. Nat. Sci. St. Louis, i, 39, .				*	
Cardium subquadratum, E. & S. " " " i, 39, .				*	
LUCINIDÆ.					
Lucina occidentalis, Morton, sp., ...				*	
Tellina occidentalis, Morton, 1842, Jour. Acad. Nat. Sci. Phila. viii, pl. xi, fig. 3.					
Lucina occidentalis, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 272.					

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
Lucina subundata, Hall & Meek, 1854, Mem. Am. Acad. Arts and Sci. Boston, v, N. S. pl. i, fig. 6, ...				*	
Lucina ventricosa, Meek & Hayden. (MSS.)					
SOLEMYIDÆ.					
Solemya subplicata, Meek & Hayden, ...					*
Solen subplicata, M. & H. Pr. Acad. Nat. Sci. Phila. April 1856, 82.					
ASTARTIDÆ.					
Crassatella Evansi, Hall & Meek, 1854, Mem. Am. Acad. Arts and Sci. Boston, v, N. S. 383, pl. i, fig. 9, ...				*	
Astarte gregaria, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 84, . .					*
MYTILIDÆ.					
Mytilus subarcuatus, Meek & Hayden, Nov. 1856, Pr. Acad. Nat. Sci. Phila. 276, ...	*				
Modiola Meekii, Evans & Shumard, sp., ...					*
Mytilus Galpinianus, E. & S. Aug. 1854, Pr. Acad. Nat. Sci. Phila. 164.					
Modiola attenuata, Meek & Hayden, ...					*
Mytilus attenuatus, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 86.					
AVICULIDÆ.					
Avicula linguiformis, Evans & Shumard, 1854, Pr. Acad. Nat. Sci. Phila. 163, ...				*	
Avicula subgibbosa, Meek & Hayden, May 1860, Pr. Acad. Nat. Sci. Phila. 180, ...					*
Avicula Nebrascana, Evans & Shumard, 1857, Trans. Acad. Sci. St. Louis, i, p. 38, ...				*	
Avicula Haydeni, Hall & Meek, 1854, Mem. Am. Acad. Sci. and Arts, Boston, v, N. S. 382, pl. i, fig. 5, ...				*	
Gervillia subtortuosa, Meek & Hayden, Nov. 1856, Pr. Acad. Nat. Sci. Phila. 276, ...				*	
Inoceramus pertenuis, Meek & Hayden, Nov. 1856, Pr. Acad. Nat. Sci. Phila. 276, ...	*				
Inoceramus ventricosus, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 87. (Non. *I. ventricosus,* Sowerby.)					
Inoceramus pertenuis, var. *subdepressus,* Meek & Hayden, ...	*				
Inoceramus subcompressus, Meek & Hayden, May 1860, Pr. Acad. Nat. Sci. Phila. 181, ...	*				
Inoceramus fragilis, Hall & Meek, 1854, Mem. Am. Acad. Arts and Sci. Boston, v, N. S. 388, pl. ii, fig. 6.		*			
Inoceramus problematicus, Schlot. sp.?, ...		*	*		
Mytilites problematicus, Schlotheim, Petrefact. 312.					
Inoceramus mytiloides, Mantell, 1822, Geol. Sussex, pl. xxvii, fig. 3, and pl. xxviii, fig. 2.					
Inoceramus problematicus, d'Orbigny, 1843, Palæont. Franc. t. iii, 510, pl. cdvi.					
Inoceramus pseudo-mytiloides, Schiel. 1855, ii, Pacific Railroad Report, 108, pl. iii, fig. 8, ...			*		

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
Inoceramus aviculoides, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 181,			*		
Inoceramus sublaevis, Hall & Meek, 1854, Mem. Acad. Arts and Sci. v, N. S. 386, pl. ii, fig. 1, ...				*	
Inoceramus convexus, Hall & Meek, 1854, Am. Acad. Arts and Sci. v, N. S. 386, pl. ii, fig. 2, ...				*	
Inoceramus tenuilineatus, H. & M. 1854, Am. Acad. Arts and Sci. v, N. S. 386, pl. ii, fig. 3, ...				*	
Inoceramus cuneatus, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 181, .				*	*
Inoceramus Sagensis, Owen (?), 1852, Report, Survey Min. Iowa, and Wiscon. 582, tab. vii, fig. 3, ...				*	
Inoceramus incurvus, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 277, .	*				
Inoceramus umbonatus, M. & H. March 1858, Pr. Acad. Nat. Sci. Phila. 50,					
Inoceramus Mortoni, M. & H. (MSS.)				*	
Inoceramus Nebrascensis, Owen, 1852, Rept. Iowa, Wiscon. and Min. 582, pl. viii, fig. 1, ...				*	
Inoceramus Vanuxemi, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 180, .				*	
Inoceramus Balchii, M. & H. " " " " 180, .				*	
ARCIDÆ.					
Arca sulcatina, Evans & Shumard, 1857, Trans. St. Louis Acad. Sci. 39, .				*	
Arca exigua, Meek & Hayden, ...				*	
Cucullæa exigua, M. & H. Nov. 1856, Pr. Acad. Nat. Sci. Phila. 275.					
Cucullæa fibrosa, Sowerby, 1818, Min. Conch. iii, 9, ...					*
Arca fibrosa, d'Orbigny, 1843, Palæont. Franc. t. iii, 212, pl. cccxii.					
Arca (cucullæa) Shumardi, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 86.					
Cucullæa cordata, Meek & Hayden, ...					*
Arca (cucullæa) cordata, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 86.					
Cucullæa cordata, M. & H. Nov. 1856, " " 285.					
Cucullæa Nebrascensis, Owen, 1852, Rept. Wiscon. Iowa, and Min. 582, pl. viii, figs. 1, 1 *a*, ...					*
Axinæa Siouxensis, Hall & Meek, sp., ...	*				
Pectunculus Siouxensis, H. & M. 1854, Mem. Acad. Arts and Sci. Boston, v, N. S. 384, pl. i, fig. 12.					
Axinæa Siouxensis, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 185.					
Axinæa subimbricata, Meek & Hayden, ...					*
Pectunculus subimbricatus, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 146.					
Axinæa subimbricatus, M. & H. May 1860, " " 185.					
Limopsis parvula, Meek & Hayden, ...					*
Pectunculina parvula, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 86.					
Limopsis parvula, M. & H. Nov. 1856, " " 285.					
LEDIDÆ.					
Leda (Yoldia) scitula, Meek & Hayden, ...					*
Nucula scitula, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 84.					
Leda scitula, M. & H. May 1860, " " 185.					

CATALOGUE OF CRETACEOUS FOSSILS, *continued.*

	Formations in ascending order.				
	1	2	3	4	5
Leda (Yoldia) E v a n s i, Meek & Hayden, ...					*
Nucula Evansi, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 84.					
Leda Evansi, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 185.					
Leda (Yoldia) v e n t r i c o s a, Hall & Meek, sp., ...					*
Nucula ventricosa, H. & M. 1854, Mem. Acad. Arts and Sci. Boston, v, N. S. 385, pl. i, fig. 11. (Non. *N. ventricosa*, Hind, 1843.*)					
Leda (Yoldia) s u b n a s u t a, Hall & Meek, sp., ...				*	
Nucula subnasuta, H. & M. Mem. Am. Acad. Arts and Sci. Boston, v, N. S. 384, pl. i, fig. 11.					
NUCULIDÆ.					
Nucula e q u i l a t e r a l i s, M. & H. April 1856. Pr. Acad. Nat. Sci. Phila. 84, .					*
Nucula s u b p l a n a, M. & H. " " " 85, .				*	
Nucula c a n c e l l a t a, M. & H. " " " 85, .					*
Nucula p l a n i m a r g i n a t a, M. & H. " " " 85, .					*
Nucula o b s o l e t a s t r i a t a, M. & H. " " " 275, .				*	
PECTENIDÆ.					
Pecten r i g i d a, Hall & Meek, 1854, Mem. Am. Acad. Sci. and Arts, Boston, v, N. S. 381, pl. ii, fig. 4, *a*, *b*, *c*, ...				*	
Pecten N e b r a s c e n s i s, M. & H. April 1856, Pr. Acad. Nat. Sci. Phila. 87, .				*	*
ANOMIADÆ.					
Anomia o b l i q u a, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 181, . .			*		
Anomia s u b t r i g o n a l i s, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 181,				*	
OSTREADÆ.					
Ostrea i n o r n a t a, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 181, . .				*	
Ostrea t r a n s l u c i d a, Meek & Hayden. (MSS.)				*	
Ostrea larva, Hall & Meek (non. Lamarck), 1854, Mem. Acad. Arts and Sci. Boston, v, N. S. 406, ...				*	
Ostrea c o n g e s t a, Conrad, 1843, Nicollet's Report, Explor. N. W. Territories, 167, ...			*		
Ostrea p a t i n a, M. & H. 1856, Pr. Acad. Nat. Sci. Phila. 277, . . .				*	
Gryphæa v e s i c u l a r i s, Lamarck? sp.				*	
Ostrea vesicularis, Lamarck, 1860, Am. Mus. viii, 160, t. 22, fig. 3.					
Ostrea deltoidea, Lamarck, 1860, Am. Mus. viii, 160, and xiv, t. 21, pars.					
Ostrea vesicularis of numerous authors.					
BRACHIOPODA?					
HIPPURITIDÆ.					
Caprinella? c o r a l o i d e a, Hall & Meek, 1854, Mem. Am. Acad. Arts and Sci. Boston, v, N. S. 381, pl. ii, fig. 3, ...				*	
RADIATA.					
FUNGIDÆ.					
Macrobacia c o r o n u l a, Goldf. sp. Petrefact. Germ. i, 50, tab. 14, fig. 10, .				*	*
VERTEBRATA.					
Mosasaurus M i s s o u r i e n s i s, Leidy, ...				*	

CHAPTER XI.

VII. Tertiary Basins of the Upper Missouri.

This system occupies so extended a geographical area in the Northwest, that it forms a most important feature in its geology. As far as it is now understood on the Upper Missouri it may be separated into two distinct divisions or basins, exhibiting well-marked lithological differences and containing organic remains peculiar to each.

1st. Great Lignite Tertiary Basin, commencing near the mouth of Cannon-ball river and extending along the Missouri nearly to the mouth of the Mussel-shell, a distance of about six hundred miles. I have traced this formation up the Yellowstone to the mouth of Big Horn river, a distance of three hundred miles. Its limits have not been ascertained with accuracy, in several directions.

2d. *Les Mauvaises Terres*, or Tertiary basin of White river, which, with its outliers, including the sandhills and Pliocene beds, occupy an area of from four hundred to five hundred miles from east to west, and four hundred to six hundred miles from north to south. Exact limits not yet ascertained.

1*st. Great Lignite Tertiary Basin.*

This great basin occupies an immense geographical area, and when thoroughly explored will undoubtedly be found the largest freshwater deposit in our country. Indeed the wide extent of country which it underlies, its influence on the external features of the country, the character and abundance of its organic remains, render it a matter of the highest interest to determine its exact age and its true relation to other Tertiary deposits. It has been known since the time of Lewis and Clarke that a deposit containing lignite, &c., existed on the Upper Missouri. Reports of a similar nature have been given to us by other travellers since that time, but no details of its lithological characters, no collection of its fossils, or other information that would enable us to determine its age or extent. The collections which have been already secured by the writer from this great deposit, show most conclusively that it possesses the mixed character of an estuary and freshwater formation, and its fossil flora indicates its age to be probably of the Miocene Tertiary.* We will now give a few of the details of its geology, together with some views in regard to its economical value to the country.

In ascending the Missouri river we meet with outliers of this deposit between Grand and Cannon-ball rivers, near lat. 46°, in the form of denuded hills. These are scattered to

* The lower portion, at least, is probably Eocene.

a greater or less extent over the prairie, resting upon Cretaceous formation No. 5 of the vertical section. At Long lake the Lignite Tertiary begins to assume considerable importance. On the left side of the Missouri from a series of denuded hills we have the following section of strata in descending order.

	Feet.
1. Yellow and drab arenaceous grit,	20 to 30
2. Impure lignite,	1
3. Gray arenaceous grit, indurated, contains a small portion of clay, also vertebrate remains, as *Compsemys victus, Emys obscurus, Trionyx*, &c.,	40
4. Impure lignite of a reddish color, with somewhat the character of a carbonaceous clay,	4
5. Rather fine-grained gray silicious grit, with a slight admixture of clay, contains great numbers of dull red argillaceous concretions, fragments of turtles mentioned in bed 3, and the bones of a huge deinosaurian, described by Dr. Leidy as *Thespesius occidentalis*,	30 to 50

The lowest bed of the above section rests directly upon the well-known Cretaceous formation No. 5 of the vertical section. Bed 5 is the same yellow sandstone seen near Fort Clark, which there contains so many freshwater and estuary shells. On the Square hills, thirty miles below Fort Clark, it becomes a heavy-bedded, coarse-grained, ferruginous sandstone, containing *Paludina, Melania Nebrascensis, M. Warrenana*, and *Corbula mactriformis.*

Near Apple creek on the Missouri, in a bank cut by the river, we have the following section of beds in descending order.

	Feet.
1. Deep yellow grit, with some clay, caps the hills.	
2. Yellow sand, passing down into a gray and dark gray grit,	40
3. Impure lignite, with a shaly structure,	1
4. Drab indurated arenaceous clay,	8
5. Impure lignite; 2 feet. First appearance of lignite immediately along the river.	
6. Gray and dark gray grit,	30

Underneath the Tertiary bed 6 comes a layer of yellow arenaceous and argillaceous grit, containing several species of *Pectunculus, Fusus*, &c. This is undoubtedly the upper portion of No. 5 of vertical section, though its fossils all have a peculiar Tertiary aspect. Indeed all the mollusca from formation No. 5 approximate so closely to well-known Tertiary forms, that I am inclined to consider it a transition or bed of passage from the Cretaceous to the Tertiary epoch.

At Fort Clark we have a bed of lignite, two feet in thickness exposed, presenting its usual characters.

1. Ferruginous sandstone, 30 to 40 feet. Near the base of the sandstone is a seam eighteen inches in thickness, composed of shell-marl, with fine specimens of *Paludina, Melania, Corbula*, &c. These shells are

distributed somewhat sparingly throughout the bed of sandstone. It also contains some fine impressions of dicotyledonous leaves. Feet.

2. Dark indurated carbonaceous clay, ... 2½
3. Lignite, of an average degree of purity, ... 2
4. Indurated clay with a reddish tinge containing much carbonaceous matter, ... 2
5. Light yellow clay with seams of carbonaceous matter disseminated through it, a sort of fine clay, 4 feet exposed above the water-level.

Thirteen miles above Fort Clark, at Red spring, on the right side of the Missouri, are a long series of nearly perpendicular bluffs, exposed by the river. This is the best locality for the collection of fossil plants I have yet seen. They are finely preserved, occur in great profusion, and belong nearly all to dicotyledonous trees. The following is a vertical section of the different beds in descending order, as they appear in this range of hills:

Feet.

1. Ferruginous marl, ... 10
2. Variegated bands of argillaceous grits, ... 30
3. Seam of impure reddish lignite, 2 inches.
4. Yellowish gray grit, with numerous concretions, in horizontal layers, filled with beautiful impressions of leaves, ... 10
5. Seam of lignite, 2 inches.
6. Yellowish gray sand with argillo-calcareous concretions, laden with impressions of dicotyledonous leaves, 10
7. Earthy lignite, 3 inches.
8. Yellow and drab clay and sandstone, containing argillaceous concretions with vegetable impressions, . 15
9. Dark reddish earthy lignite, 4 inches.
10. Yellow argillaceous grit, ... 20
11. Alternate layers of lignite and clay varying in thickness at different localities within a distance of four miles, ... 4 to 15
12. Heavy-bedded friable sandstone, very ferruginous, varying in color from yellow to gray and yellowish gray. Same bed, I think, as seen at Fort Clark and on the summit of Square hills, containing so many fossils. Here we have *Melania Nebrascensis*, *Paludina multilineata*, and *Corbula matriformis*, . . . 40
13. Seam of lignite, 2 inches.
14. Gray argillaceous grit, ... 4
15. Lignite of excellent quality, ... 2
16. Bluish gray clay, slightly arenaceous, ... 6
17. Lignite near water's edge, quite pure, ... 3 to 4

Beneath bed 17 may be seen at low water a heavy-bedded gray sandstone.

In speaking of lignite as of a good quality, I mean, that it contains a small amount of earthy material, but I have not yet seen any of it that would be of much value for economical purposes.* Specimens from this locality and from Fort Berthold, forty miles above,

* I am satisfied that some of the beds of lignite, especially those on the Yellowstone, can be used for fuel, when the country is sufficiently settled to induce a demand for it. There are some excellent beds of lignite on the North

present the following characters on examination: contain no bitumen; sublaminated structure; compact fragments have a somewhat conchoidal fracture and a jet shining black color; almost always reveal the vegetable fibre; ignites very slowly; burns with a light yellowish flame, and emits a sulphurous smell.

Throughout the denuded portions of this formation, great quantities of silicified wood are found in a fine state of preservation and so close is the resemblance that it may readily be mistaken at a distance for recent wood. Near the foot of the Great Bend of the Missouri, above Fort Berthold, I observed a silicified stump near the base of the bluff, standing upright, three feet in diameter, with a cavity in the centre 6 inches in diameter, and so perfectly is the original fibre preserved, that the layers of growth are as distinct as in the stump of a tree just felled with the axe.

Near the Great Bend the surface of the country presents an exceedingly rugged appearance, and is called by the Indians and traders "Les Mauvaises Terres," or Bad Lands. The bluffs here afford fine examples of the spontaneous ignition of the lignite beds, by which the superincumbent strata are fused or heated to various degrees of compactness, sometimes giving the hills the appearance of an accumulation of fragments of burnt bricks. Oftentimes the clays and sands contiguous to the lignite beds are fused, so as to exhibit every variety of character, from a nearly vitreous mass to a light vesicular lava with a specific gravity less than water. Many of these light vesicular masses fall down to the edge of the river, and the current in high water carries them down, scattering them on sandbars and bottoms, even below St. Louis, and thus the origin of the opinion that there were volcanic products somewhere near the sources of the Missouri.

Section of strata at Crow hills, about one hundred miles below Fort Union:

	Feet.
1. Yellow and gray arenaceous marl with horizontal layers of hard concretionary rocks, containing some impressions of plants,	30 to 40
2. Impure lignite, 4 inches.	
3. Indurated clay, ferruginous, with many deep iron-rust concretions,	30
4. Reddish drab, indurated arenaceous and argillaceous grit,	15
5. Eight inches earthy lignite. Twelve inches yellow clay. Four inches earthy lignite.	
6. Yellow and yellowish gray sandstone, with irregular seams of clay. This bed contains many species of shells, and distinct impressions of a species of fern in a black compact clay rock, exposed,	30

One of the most interesting portions of the country occupied by the lignite deposit is in the region surrounding Fort Union, not only on account of its geological peculiarities, but also from the number and variety of its fossils. Scattered over the denuded hills on both

Platte, 18 inches to 2 feet in thickness, which has been used with success at a military station near it. It will not, however, supply sufficient heat for welding iron.

sides of the Missouri river are great quantities of the shells of mollusca in a fine state of preservation, looking very much like those strewn upon the shores of our present rivers or lakes. Silicified wood occurs everywhere in the greatest abundance, in the same perfect state of preservation before mentioned.

A vertical section of the different beds in descending order, as exposed within twenty or thirty miles of Fort Union, would be as follows:

	Feet.
1. Ferruginous marl, with arenaceous concretions, caps the hills, and is covered with angular blocks of granite; sometimes the upper part of this bed for several feet in thickness is composed of concretionary sandstone, forming ledges. Most common fossil, *Paludina trochiformis*,	20 to 30
2. Drab indurated arenaceous clay,	20
3. Impure lignite with numerous crystals of selenite, 12 inches.	
4. Gray and drab indurated clay, contains at various localities very abundant impressions of leaves of dicotyledonous trees with a species of fern,	50 to 70
5. Impure lignite with much silicified wood. One mass lay in the bed eighteen inches in diameter, and thirty feet in length, 18 inches.	
6. Gray indurated sand, with a slight mixture of clay, contains numerous freshwater mollusca, as *Paludina trochiformis, P. retusa, P. Leai, P. Leidyi, Melania Nebrascensis,* also many fragments and entire stumps of silicified trees, among the debris of which I noticed that the shells were most abundant,	30
7. Impure lignite, 4 inches.	
8. Dark gray and drab indurated sand,	20 to 30

About six miles northeast of Fort Union a local bed occurs, containing a somewhat peculiar class of fossils, of freshwater and land species, a section of which I give to show the position of the fossils.

	Feet.
1. Indurated silicious grit, variable in color and structure, sometimes light gray, drab or ferruginous, with layers of clay and concretionary sandstone, near the lower portion of the bed. The terrestrial and fluviatile shells are inclosed in a hard reddish carbonaceous matrix, thrust in between layers of the sandstone,	80 to 100
2. Impure lignite,	2
3. Yellowish gray indurated clay.	

The lower portion of bed 1 of the above section contains at this locality a profusion of land and freshwater shells, inclosed in a compact matrix, well calculated to preserve them. The bed occupies an area of only a few yards square, exposed in the channel of a little stream, and was observed nowhere else on the Missouri.

The mollusca that occur at this locality, though belonging to extinct species, are closely allied to forms now living on the land and in the little streams of the country. The species as yet described from this place are *Cyclas fragilis, C. subellipticus, C. formosa, Pupa heli-*

coides, Physa longiuscula, P. rhomboidea, P. Nebrascensis, Planorbis subumbilicatus, Ancylus minuta, Valvata parvula, Bulimus? teres, B. vermiculus. The last two species will doubtless prove to belong to the genus *Clausilia*, or to an intermediate new genus between *Bulimus* and *Clausilia*. There were also many seeds of plants in this ligneous material. The upper portion of this bed is a dark gray silicious grit, sometimes of a drab color, from the numerous particles of coaly matter which are disseminated through it. It contains numerous impressions of dicotyledonous leaves, of the same species with those found in the same bed ten miles below this point, and holding nearly the same position. But one of the most remarkable features of this bed at this locality, is the presence of myriads of spherical concretions, covering an area of several miles in extent. They vary in size from half an inch to several feet in diameter, and are formed of thin layers of sandstone, concentrically arranged about a nucleus. They contain much ferruginous matter, of a grayish color internally, but becoming of a reddish iron-rust color on exposure.

About thirty miles below the mouth of Milk river the beds of the lignite basin begin sensibly to rise above the water-level of the Missouri, by the reversed dip of the strata, and on reaching Round Butte they cap the hills, though still maintaining considerable thickness. Near the mouth of Mussel-shell river, the Cretaceous formation No. 4 occupies the country, the lignite beds having entirely disappeared. At Round Butte the lignite deposit is mostly seen in outliers in the form of denuded conical hills, scattered over the broad upland plateau, the highest about one hundred feet, resting upon No. 4 or a blending of Nos. 5 and 4, which have a thickness of two or three hundred feet. The northern outliers of the lignite basin pass off on the Cretaceous hills, presenting very similar lithological characters to those along the southern border.

The same deposit underlies the country bordering upon the Yellowstone, at least to the mouth of the Big Horn, which is the highest point to which my explorations have extended. It presents nearly the same lithological characters as on the Missouri, and most of its organic remains are specifically identical.

Near the mouth of the Yellowstone river are a series of hills, composed of variegated sands and clays, with some impure lignite and large numbers of animal and vegetable remains.

Near O'Fallon's creek, about one hundred miles by land above the mouth of the Yellowstone, is a very high rugged portion of country, called Bad Lands, which is cut through by the river, so as to expose a fine vertical section of the strata. This section will represent most of the Tertiary beds seen on the Yellowstone, but they vary much in thickness and appearance at different localities.

SECTION OF TERTIARY BEDS NEAR O'FALLON'S CREEK, ON THE YELLOWSTONE.

		Feet.
1.	Yellowish flesh-colored marl. The upper portion of the bed is a rather coarse-grained reddish sandstone, with many large Unios, too imperfect to characterize,	20 to 30
2.	Reddish drab indurated clay,	10
3.	Dark drab indurated clay,	30
4.	Earthy lignite, 2 inches, Dark drab indurated clay, 4 inches, Impure lignite, 2 inches, Yellow clay with concretions, 2 feet, Impure lignite, 2 inches, Carbonaceous clay, 3 inches, Impure lignite, 2 inches, — in all, over	3
5.	Dark drab indurated arenaceous clay,	30
6.	Lignite, quite pure, 18 inches.	
7.	Deep yellow ferruginous grit, contains a few shells, as *Paludina*, *Corbula*, &c., and impressions of leaves,	25
8.	Lignite, quite pure, 18 inches. Very dark carbonaceous clay, Lignite of good quality, 2 feet.	8 to 15
9.	Light gray sand, reaching to water's edge at this point, though reposing on Cretaceous formation No. 4 a few miles below, exposed,	30 to 40

In bed 9 of the above local section we find numerous argillo-calcareous concretions, containing distinct impressions of leaves of dicotyledonous trees, *Smilax*, *Acer*, *Ulmus*, &c. I think this bed holds the same position as the lowest sand-bed seen on Moreau river near Thunder hill and on Cherry creek. Plants and shells are found to some extent in all the strata of clay, especially near the lignite beds. Bed 8, a few miles down the river, becomes a solid stratum of lignite, seven feet in thickness, and is the largest bed of this material seen on the river. After passing the mouth of Powder river it diminishes in thickness and becomes more impure, and thus continues to the mouth of Big Horn river, the limit of my observations. I have no doubt, however, that, like the same beds on the Missouri, the Tertiary beds soon disappear on the high hills (the strata dipping toward the east apparently), and give place to formations of older date. In the summer of 1854, I received from intelligent traders, specimens of *Inoceramus* and *Ammonites* from a locality near Clark's fork, a branch of the Yellowstone, which is on the same parallel with Mussel-shell river, where the well-known Cretaceous formation No. 4 reaches its largest development on the Missouri.

Throughout the region of the Yellowstone, silicified wood is found in the greatest abundance, so that many portions have been called by the trappers "petrified forests." There is everywhere evidence of an exceedingly luxuriant growth of timber during the Tertiary period.

The spontaneous ignition of the lignite beds, and its influence on the contiguous strata,

is nowhere better exhibited than in the country bordering upon the Yellowstone. Often ranges of hills extending back from the river into the interior for several miles, form a series of high bluff ledges of the fused or semifused rocks, somewhat variegated, but mostly of a lively red color, giving to the country the appearance of the ruins of a large city. The light vesicular pumice-like masses have been scattered by the wind over the plateaus surrounding these hills, and are sometimes carried a mile or more from the original position. Even at the present time, I observed several places where the lignite beds were in a state of combustion, both on the Missouri and on the Yellowstone, and the atmosphere is filled with smoke, and the sulphurous smell which issues from these fires is exceedingly offensive to the traveller.

The same phenomena have been observed in the far North, in the lignite beds on Mackenzie's river. Mr. Simpson, a gentleman who travelled quite extensively in the Hudson Bay territory, from 1836 to 1839, says of the beds of that region,—"Wood-coal was in a state of combustion for several miles on both sides of the Mackenzie, and these natural fires seem to have spread considerably since last described by Dr. Richardson. The jets of smoke issuing in many places from the perpendicular face of the clayey cliffs, presented a singular spectacle. The combustion had in many places scorched the layers of unctuous earth that interstratify the coal formation, and turned their surface to a lively red color."*

In regard to the age of the lignite formations described by Mr. Simpson, we have no reliable information. It is probable that they are synchronous with those on the Upper Missouri, but some portion of them may belong to the Cretaceous period.

We will now return to the Missouri river, and trace the lignite strata westward, into the interior toward the Black hills along their southern boundaries. In latitude 46½°, longitude 100½°, near the mouth of Cannon-ball river, we have distinct indications of this formation in the numerous conical hills which have been left after denudation; and scattered around these denuded hills are many fragments of finely preserved silicified wood, with a few estuary shells. Proceeding in a southwest direction from the mouth of Cannon-ball river, we find the outliers of the lignite formation, resting upon Cretaceous bed No. 5 of the vertical section, and on reaching Grand river, eighty miles above its mouth, the Tertiary strata occupy the surface of the country, the Cretaceous beds appearing only in the channels of the streams. At Thunder Butte we have a fine section of the Tertiary beds. This is a hill left after the denudation of the surrounding country, rising above the level prairie to the height of three hundred feet. The strata are perfectly horizontal, and the following beds in descending order will show the character of the hill:

* Thomas Simpson's Journal of Discoveries on the North Coast of America, during the years 1836 to 1839; pages 97 and 98.

	Feet.
1. Coarse-grained gray sandstone, very compact and hard at summit, but becoming more friable at base,	100 to 150
2. A variable bed of yellowish gray loose sand and clay, with here and there a small seam of lignite, and some argillo-calcareous concretions,	100
3. Dull reddish argillaceous lignite, 18 inches.	
4. Gray ferruginous silicious grit, becoming yellow on exposure, with numerous argillo-silicious concretions, some gray, others of a reddish color. This bed contains bones of vertebrate animals and estuary shells, as *Cyrena*, &c.,	30 to 40

Bed 4 of the above local section rests directly upon Cretaceous formation No. 5, and is of an estuary character. Wherever the superincumbent strata are denuded away, the surface of this bed is covered with fragments of bones belonging to some huge sauroid or manatoid animal. These bones are scattered very abundantly over the country about the sources of the Moreau, Grand, Cannon-ball, and Little Missouri rivers, and are for the most part much waterworn and uncharacteristic. On Cherry creek this bed attains considerable thickness, fifty to one hundred feet, capped with large ledges of sandstone, containing a species of *Cyrena* in large numbers. Near the head of the Little Missouri, an important stream, which takes its rise near the northern base of the Black hills and running a northeastern course empties into the Missouri river near long. 102°, we find another species of mollusc, *Cerithium Nebrascensis*, which further confirms the estuary character of this deposit. We can thus trace this lignite formation to the northern base of the Black hills, and observe its edges overlapping the Cretaceous beds. But to return to Thunder Butte. The summit of this hill is capped with a thick layer of sandstone, the exact position of which I could not determine satisfactorily. A similar rock is seen capping the hills at Fort Union, also in many localities along the Yellowstone, and may hold the same position in the series. On the eastern side of the hill, the bed of sandstone presents a perpendicular face, from which have been detached large fragments of the rock, that have fallen on a terrace below. This terrace is about half the way up the hill, and about one hundred yards broad at its widest part, and thickly scattered over it are huge masses of a compact bluish sandstone, which look at a distance like large granite boulders.

The extent of country occupied by this great basin I have estimated at about four hundred miles in length from east to west, and one hundred and fifty from north to south, or about sixty thousand square miles. We thus arrive at an approximate idea of the immense area covered by these lignite beds, though I am satisfied that future explorations will show that the above estimate is much too small.

I have thus given a brief and imperfect sketch of this great basin, comprising all the important facts in my possession at this time. The local sections will, I think, show the

lithological characters of the strata, and will enable the geological reader to compare them with those of other freshwater deposits in that region. I regret that I cannot yet give a complete general section of all the beds in the lignite basin, but, as I hope soon to continue my explorations in that interesting country, this desire may yet be accomplished. In a subsequent portion of this report I have reviewed in some general remarks the principal points of interest now known in connection with this deposit.

The following catalogue comprises all the fossils yet known and examined from this basin. The vertebrata and mollusca thus enumerated show quite distinctly that they represent but fragments of a large and interesting fauna, the complete discovery of which still remains to reward the future explorer. The fossil plants have not yet been described, but the collection already secured contains about fifty species, all of which are supposed to be new to science. These plants cannot represent more than a small portion of the flora of this period, and future examinations must greatly multiply the number of species.

TERTIARY SPECIES.*

VERTEBRATA.

Thespesius occidentalis, Leidy, Proc. Acad. Nat. Sci. Phila. 1856, 311, and Trans. Am. Phil. Soc. 1859, 151.
Ischyrotherium antiquum, Leidy, " " " 89, " " " 150.
Mylognathus priscus, Leidy, " " " 312, " " " 153.
Compsemys victus, Leidy, " " " 73, 312, " " " 152.
Emys obscurus, Leidy, " " " " " " " 153.

GASTEROPODA.

CERITHIADÆ.

Cerithium (Cerithidea?) Nebrascensis, M. & H. June 1860, Pr. Acad. Nat. Sci. Phila. 125.

MELANIADÆ.

Melania? Warreni, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 137.
Melania subtortuosa, M. & H. " " " 136.
Melania Nebrascensis, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 124.
Melania tenuicarinata, M. & H. May 1857, " " 137.
Melania convexa, M. & H.
Turritella convexa, M. & H. March 1856, Pr. Acad. Nat. Sci. Phila. 71.
Melania convexa, M. & H. " " " 125.
Melania sublevis, M. & H. " " " 136.
Melania? Anthonyi, M. & H. " " " 124.
Melania minitula, M. & H. June 1856, " " 123.

VIVIPARIDÆ.

Vivipara Conradi, Meek & Hayden.
Paludina Conradi, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 122.
Vivipari Conradi, M. & H. May 1860, " " 185.
Vivipara Nebrascensis, Meek & Hayden.
Paludina multilineata, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 120. (Non *P. multilineata*, Say, 1829.)
Vivipara multilineati, M. & H. May 1860, " " 185.

* The Catalogue of Invertebrata here given, is extracted from a catalogue of Nebraska fossils published by Mr. Meek and myself in the Proceedings of the Academy, in Oct. 1860.

Vivipara L e a i, Meek & Hayden.
Paludina Leai, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 121.
Vivipara Leai, M. & H. May 1860, " " 185.

Vivipara v e t u s t a, Meek & Hayden.
Paludina vetusta, M. & H. 1856, Pr. Acad. Nat. Sci. Phila. 121.

Vivipara retusa, Meek & Hayden.
Paludina retusa, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 122.
Vivipara retusa, M. & H. May 1860, " " 185.

Vivipara t r o c h i f o r m i s, Meek & Hayden.
Paludina trochiformis, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 122.
Paludina Leidyi?, M. & H. " " " 123.
Vivipara trochiformis, M. & H. May 1860, " " 185.

VALVATIDÆ.

Valvata s u b u m b i l i c a t a, Meek & Hayden.
Planorbis subumbilicata, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 120.
Valvata subumbilicata, M. & H. May 1860, " " 185.
Valvata parvula, M. & H. June 1856, " " 123.

HELICIDÆ.

Columna? t e r e s, Meek & Hayden.
Bulimus? teres, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 117.

Columna? v e r m i c u l u s, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 118.
Bulimus? vermiculus, M. & H. " " " 118.
Bulimus l i m n e i f o r m i s, M. & H. " " " 118.
Bulimus Nebrascensis?, M. & H. " " " 118.

Helix L e i d y i, Hall & Meek, June 1854, Mem. Am. Acad. Arts and Sci. Boston, v, N. S. 394, pl. iii, fig. 12.

Helix v e t u s t a, Meek & Hayden.
H. vitrinoides, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 135. (Non *H. vitrinoides*, Deshayes, 1830.)
Helix o b l i q u a, M. & H. " " " 134.
Helix E v a n s i, M. & H. May 1860, " " 175.

Helix (Polygyra) a m p l e x u s, Meek & Hayden.
Planorbis amplexus, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 21.
Helix (Polygyra) amplexus, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 185.

Helix N e b r a s c e n s i s, Meek & Hayden.
H. occidentalis, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 135. (Non *H. occidentalis*, Recluz, 1845.)

LIMNÆIDÆ.

Limnæa (Acella) t e n u i c o s t a t a, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 119.

Limnæa? m u l t i s t r i a t a, Meek & Hayden.
Melania multistriata, M. & H. June 1826, Pr. Acad. Nat. Sci. Phila. 124.

Physa (Aplexus) l o n g i u s c u l a, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 119.
Physa (Aplexus) s u b e l o n g a t a, M. & H. " " " 120.
Physa r h o m b o i d e a, M. & H. " " " 119.

Planorbis (Segmentina?) N e b r a s c e n s i s, Evans & Shumard, August 1854, Pr. Acad. Nat. Sci. Phila. 164.
Planorbis (Segmentina?) v e t u l u s, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 175.
Planorbis L e i d y i, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 175.
Planorbis c o n v o l u t u s, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 120.

Planorbis planoconvexus, Meek & Hayden.
Planorbis fragilis, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 136. (Non *P. fragilis*, Dunker, 1843.)
***Planorbis planoconvexus*, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 185.**
Ancylus (Acroloxus) minuta, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 120.

CONCHIFERA.

CORBULIDÆ.

Corbula perundata, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 116.
Corbula (Potamomya) subtrigonalis, Meek & Hayden.
Corbula subtrigonalis, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 116.
Corbula (Potamomya) mactriformis, Meek & Hayden.
Corbula mactriformis, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 117.

CYRENIDÆ.

Corbicula Moreauensis, Meek & Hayden.
Cyrena Moreauensis, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 115.
Corbicula Nebrascensis, Meek & Hayden.
Cyrena intermedia, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 116. (Non *Cyrena (Corbicula) intermedia*, Melville, 1843.)
Corbicula cytheriformis, Meek & Hayden.
Cyrena (Corbicula?) cytheriformis, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 176.
Corbicula occidentalis, Meek & Hayden.
Cyrena occidentalis, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 116.
Sphærium planum, M. & H. May 1860, " " 175.
Sphærium formosum, Meek & Hayden.
Cyclas formosa, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 115.
Cyclas fragilis, M. & H. " " " 115.
Sphærium formosum, M. & H. May 1860, " " 185.
Sphærium subellipticum, Meek & Hayden.
Cyclas subelliptica, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 115.
Sphærium subellipticum, M. & H. May 1860, Pr. Acad. Nat. Sci. Phila. 185.
Sphærium recticardinale, M. & H. " " " 176.

UNIONIDÆ.

Unio priscus, M. & H. June 1856, Pr. Acad. Nat. Sci. Phila. 117.
Unio subspatulatus, M. & H. May 1857, Pr. Acad. Nat. Sci. Phila. 146.
Unio Deweyanus, M. & H. " " " 145.
Unio Danæ, M. & H. " " " 146.

OSTREADÆ.

Ostrea subtrigonalis, Evans & Shumard, 1857, Trans. St. Louis Acad. Sci. i, 38.
Ostrea glabra, Meek & Hayden, Pr. Acad. Nat. Sci. Phila. 146.

2d. Les Mauvaises Terres, or Tertiary Basin of White and Niobrara rivers.

This most remarkable lacustrine deposit has been, comparatively speaking, but recently made known to the scientific world, wonderful not alone for its unique scenery, but also for the abundance and importance of its organic remains. Even at this time it has been but partially explored, yet it has already revealed a profusion of Mammalian and Chelonian remains belonging to species, and in many cases to genera, which though closely allied differ from all known living forms, which has now rendered it classic ground to the geologist and palæontologist. A history of the progress of its exploration up to 1853, with elaborate descriptions of the vertebrata known from this deposit up to that date, may be found in a magnificent memoir written by Prof. Joseph Leidy, and published by the Smithsonian Institution.

In its lithological characters this deposit differs very materially from the lignite basin, being composed of whitish clays and calcareous and silicious marls and grits, and entirely destitute, so far as we now know, of any vegetable remains, except very rare fragments of silicified wood. It is chiefly remarkable, however, as a vast deposit, in which were entombed immense numbers of Mammalian and Chelonian animals, for the beauty and perfection with which these remains have been preserved, and its unique rugged scenery. The few molluscous fossils which have been found in it, show most conclusively its freshwater origin, being confined to the genera *Helix*, *Planorbis*, *Limnea*, &c. I have already embodied the principal details in regard to this interesting deposit in a preceding chapter, and in a subsequent portion I will briefly state such evidence as I have been able to secure, to show that it is of Miocene age. The following vertical section comprises all the beds known up to this time, and it is not probable that future explorations will modify it materially.

VERTICAL SECTION, SHOWING THE ORDER OF SUPERPOSITION OF THE DIFFERENT BEDS OF THE TERTIARY BASIN OF WHITE AND NIOBRARA RIVERS.

	Subdivisions.		Localities.	Estimated thickness.
POST PLIOCENE.		Yellow silicious marl, similar in its character to the Loess of the Rhine, passing down into variegated indurated clays and brown and yellow fine grits; contains remains of extinct quadrupeds, mingled with those identical with recent ones; also a few mollusca, mostly identical with recent species so far as determined.	Most fully developed along the Missouri river, from the mouth of the Niobrara to St. Joseph; also in the Platte valley and on the Loup Fork; also largely exhibited in the valley of the Mississippi and in and over the Southwest.	300 to 500 feet.

VERTICAL SECTION, *continued.*

	Subdivisions.		Localities.	Estimated thickness.
PLIOCENE TERTIARY.	Bed F.	1st. Dark gray or brown sand, loose, incoherent, with remains of mastodon, elephant, &c. 2d. Sand and gravel, incoherent. 3d. Yellowish white grit, with many calcareous, arenaceous concretions. 4th. Gray sand with a greenish tinge; contains the greater part of the organic remains. 5th. Deep yellowish red arenaceous marl. 6th. Yellowish gray grit, sometimes quite calcareous, with numerous layers of concretionary limestone from two to six inches in thickness, containing freshwater and land-shells, Succinea, Limnea, Paludina, Helix, &c., perhaps all identical with living species; also much wood of coniferous character.	Covers a very large area on Loup fork, from the mouth of North branch to source of Loup fork; also in the Platte valley. Most fully developed on the Niobrara river, extending from the mouth of Turtle river three hundred miles up the Niobrara. Also on Bijoux hills and Medicine hills. Thinly represented in the valley of White river. In isolated patches over a large portion of Dakota territory, west of the Coteau de Prairie.	300 to 400 feet.
MIOCENE.	Bed E.	Usually a coarse-grained sandstone, sometimes heavy-bedded and compact; sometimes loose and incoherent; varies much in different localities. Forms immense masses of conglomerate; also contains layers of tabular limestone with indistinct organic remains; very few mammalian remains detected, and those in a fragmentary condition. Passes gradually into the bed below.	Most fully developed along the upper portion of Niobrara river and in the region around Fort Laramie. Seen also on White river and on Grindstone hills.	180 to 200 feet.
	Bed D.	A dull reddish brown indurated grit, with many layers of silico-calcareous concretions, sometimes forming a heavy-bedded fine-grained sandstone; contains comparatively few organic remains.	Niobrara and Platte rivers; well developed in the region of Fort Laramie; also in the valley of White river. Conspicuous, and composing the main part of the dividing ridge between White and Niobrara rivers. Also in Green river valley.	350 to 400 feet.
	Bed C.	Very fine yellow calcareous sand, not differing very materially from bed D, with numerous layers of concretions and rarely organic remains, passing down into a variegated bed, consisting of alternate layers of dark brown clay and light gray calcareous grit, forming bands, of which I counted twenty-seven at one locality, varying from one inch to two feet in thickness.	White river, Bear creek, Ash Grove spring, head of Shyenne river. Most conspicuous near White river. Near the eastern base of the Black hills.	50 to 80 feet.
	Turtle and Oreodon Bed B.	A deep flesh-colored argillo-calcareous indurated grit; the outside, when weathered, has the appearance of a plastic clay. Passes down into a gray clay, with layers of sandstone; underlaid by a flesh-colored argillo-calcareous stratum, containing a profusion of mammalian and chelonian remains. Turtle and Oreodon Bed.	Old Woman's creek, a fork of Shyenne river; also on the head of the South fork of the Shyenne; most conspicuous on Sage and Bear creeks, and at Ash Grove spring. Well developed in numerous localities in the valley of White river.	80 to 100 feet.

VERTICAL SECTION, *continued*.

		Subdivisions.	Localities.	Estimated thickness.
MIOCENE.	Titanotherium Bed A.	Light gray fine sand, with more or less calcareous matter, passing down into an ash-colored plastic clay, with large quantities of quartz grains disseminated through it, sometimes forming aggregated masses like quartzose sandstone cemented with plastic clay; then an ash-colored clay with a greenish tinge, underlaid at base by a light gray and ferruginous silicious sand and gravel, with pinkish bands. Great quantities of silex in the form of seams all through the beds. Titanotherium Bed.	Old Woman's creek; also in many localities along the valley of the South fork of Shyenne. Best development on Sage and Bear creeks. Seen at several localities in the valley of White river.	80 to 100 feet.
CRETACEOUS.	Nos. 4 and 5.	Cretaceous beds 5 and 4, with their usual lithological characters and fossils.	Exposed underneath the tertiary beds on the South fork of Shyenne and its southern branches, also in White river valley near its source.	

CATALOGUE OF ALL THE FOSSILS HITHERTO DESCRIBED, FROM THE TERTIARY FORMATIONS OF WHITE AND NIOBRARA RIVERS, WITH A TABLE SHOWING THEIR STRATIGRAPHICAL POSITION.

	Beds in ascending order. A.	B.	C.	D.	E.	F.
RUMINANTIA.						
1. *Oreodon gracilis*, Leidy,				*	*	*
2. *Oreodon Culbertsoni*, Leidy,				*	*	*
3. *Oreodon major*, Leidy,				*		*
4. *Agriocharus major*, Leidy,				*		*
5. *Agriocharus antiquus*, Leidy,				*		*
6. *Poebrotherium Wilsoni*, Leidy,				*		
7. *Leptomeryx Evansi*, Leidy,				*		*
8. *Leptauchenia decora*, Leidy,						*
9. *Leptauchenia major*, Leidy,						*
10. *Protomeryx Halli*, Leidy,						*
11. *Merycodus necatus*, Leidy,							*
12. *Megalomeryx Niobrahensis*, Leidy,							*
13. *Merychocharus proprius*, Leidy,					*		
14. *Procamelus occidentalis*, Leidy,							*
15. *Procamelus robustus*, Leidy,							*
16. *Procamelus gracilis*, Leidy,							*
17. *Merychyus elegans*, Leidy,							*
18. *Merychyus medius*, Leidy,							*
19. *Merychyus major*, Leidy,							*
20. *Cervus Warreni*, Leidy,							*

	Beds in ascending order. A.	B.	C.	D.	E.	F.
MULTUNGULA.						
21. *Chæropotamus* (*Hyopotamus*) *Americanus*, L.	*					
22. *Entelodon Mortoni*, Leidy,					*	*
23. *Entelodon ingens*, Leidy,					*	*
24. *Titanotherium Prouti*, Leidy,				*		
26. *Paleocharus probus*, Leidy,					*	*
27. *Leptocharus spectabilis*, Leidy,					*	*
28. *Rhinoceros occidentalis*, Leidy,					*	*	*
29. *Rhinoceros* (*Hyracodon*) *Nebrascensis*, Leidy,					*	*	*
30. *Rhinoceros crassus*, Leidy,							*
31. *Mastodon* (*Tetralophodon*) *merificus*, Leidy,							*
32. *Elephas* (*Euelephas*) *imperator*, Leidy,							*
SOLIDUNGULA.						
33. *Hipparion*, *S. Hippotherium occidentale*, L.							*
34. *Hipparion*, *S. Hippotherium speciosum*, L.							*
35. *Anchitherium Bairdi*, Leidy,					*		
36. *Anchitherium* (*Hypohippus*) *affinis*, Leidy,						*	
37. *Anchitherium* (*Parahippus*) *cognatus*, Leidy,						*	
38. *Merychippus insignis*, Leidy,							*
39. *Merychippus mirabilis*, Leidy,							*

	Beds in ascending order. A.	B.	C.	D.	E.	F.
40. *Equus excelsus*, Leidy,						*
41. *Equus* (*Protohippus*) *perditus*, Leidy,						*
RODENTIA.						
42. *Steneofiber Nebrascensis*, Leidy,				*	*	
43. *Ischyromys typus*, Leidy,				*	*	
44. *Palæolagus Haydeni*, Leidy,				*	*	
45. *Eumys elegans*, Leidy,				*		
46. *Hystrix* (*Hystricops*) *venustus*, Leidy,					*	*
47. *Castor* (*Eucastor*) *tortus*, Leidy,						*
CARNIVORA.						
48. *Hyænodon horridus*, Leidy,				*		
49. *Hyænodon eruentus*, Leidy,				*		
50. *Hyænodon crucians*, Leidy,				*		
51. *Amphicyon vetus*, Leidy,				*		
52. *Amphicyon gracilis*, Leidy,				*		
53. *Leptarctus primus*, Leidy,						*
54. *Deinictis felina*, Leidy,				*		
55. *Machairodus primævus*, Leidy,				*		

	Beds in ascending order. A.	B.	C.	D.	E.	F.
56. *Felis* (*Pseudælurus*) *intrepidus*, Leidy,						*
57. *Ælurodon ferox*, Leidy,						*
58. *Canis sævus*, Leidy,						*
59. *Canis temerarius*, Leidy,						*
60. *Canis vafer*, Leidy,						*
61. *Canis* (*Epicyon*) *Haydeni*, Leidy,						*
CHELONIA.						
62. *Testudo Nebrascensis*, Leidy,				*	*	*
63. *Testudo* (*Stylemys*) *Niobrahensis*, Leidy,						*
MOLLUSCA.						
64. *Helix Leidyi*, Hall and Meek,				*		
65. *Planorbis Nebrascensis*, Evans and Shumard,						*
66. *Lymnea diaphana*, Evans and Shumard,						*
67. *Lymnea Nebrascensis*, Evans and Shumard,						*
68. *Physa secalina*, Evans and Shumard,						*
CRUSTACEA.						
69. *Cypris Leidyi*, Evans and Shumard,						*

CHAPTER XII.

Quaternary Deposits.

Although the various superficial deposits which I include under the above caption are very fully developed in the Northwest, and exert a great influence on the external features of the country, I shall be able, in this connection, to speak of them only in a brief and general way. I propose, however, to treat the subject more thoroughly in a future official report, now in course of preparation. This division, which has been called surface geology, is by no means greatly inferior in importance or interest to the others before treated, and no country affords more suitable or more abundant material for a memoir on that subject than the Northwest. The extensive area covered by deposits of sand, gravel, water-worn boulders, and erratic blocks, the examples of the denuding and eroding power of water, which have given such unique features to much of the scenery, the river terraces, and yellow marl or bluff formation,—all these subjects will, when thoroughly studied, add very greatly to the interest felt in this department of geological research.

In Prof. Swallow's Geological Report of the State of Missouri, the Quaternary deposits as they occur along the Missouri river, from its mouth to Council bluffs, are quite fully discussed, and inasmuch as they are of a similar character where they are observed from

thence to the mountains, I shall speak of them in a similar manner, acknowledging my indebtedness to his report for several important suggestions.

Prof. Swallow makes four subdivisions of the superficial deposits of the State of Missouri, and as seen on the Upper Missouri I will add one more, namely, Erratic Block Deposit. We have therefore 1st, Drift; 2d, Yellow Marl Formation; 3d, Erratic Block Deposit; 4th, Bottom Prairie; 5th, Alluvium.

1*st. Drift.**

This deposit consists mostly of much waterworn rocks, gravel, and sand, and underlies, to a very great extent, the broad upland prairies of the Northwest. It is usually revealed in the channels of streams and varies in thickness from one to thirty feet. It is found to a greater or less extent throughout the entire country drained by the Missouri river and its tributaries, resting upon rocks of all ages, from the granite to the Tertiary inclusive, but is most largely developed in the vicinity of the mountain ranges, as the Laramie mountains, the Black hills, and the sources of the Missouri and Yellowstone. So abundant is the drift toward the sources of these rivers, that it changes their entire character. The waters of the Yellowstone at its mouth are turbid, flowing over a bed of marly clay, like those of the Missouri from Fort Union to its confluence with the Mississippi; but about fifty miles above the mouth of the Yellowstone smooth waterworn pebbles begin to appear, small in size and few in number at first, but becoming larger and increasing in quantity, and when we reach a point two hundred miles above its confluence with the Missouri, they completely pave the bed of the river, and form the greater portion of the materials which compose the river bottoms in very large areas to the depth of thirty feet and more. From this fact the waters of the Yellowstone gradually lose their turbid character, and near the mountains are clear as crystal. The waters of the Missouri also become less opaque after passing the mouth of Mussel-shell river, and near the Judith roll over a pebbly bed as clear as the mountain streams. The drift seems to underlie all the vast table-land to the northward, continually increasing in extent and thickness as we approach the base of the mountains, and oftentimes concealing the older rocks over very large areas.

Much might be said in regard to this deposit and the agencies which have operated in

* I am well aware that the term "Drift" as used in this connection has not a fixed or definite meaning. I have applied it to certain sand, gravel, pebbly clay and boulder accumulations, which are always found at the base of the Quaternary deposits of the West, filling up the inequalities of the surface of the lower rocks, and may or may not have been accumulated by a force operating over the whole continent.

its formation, but I prefer to delay until a larger number of facts can be gathered together from a more widely extended exploration.

2d. *Yellow Marl or Bluff formation.*

The yellow marl formation is one of great interest, inasmuch as it exerts a favorable influence on the agricultural capacities of the country where it prevails. Its general character is a light, rather pulverulent silicious marl, in most cases unstratified, containing large quantities of yellowish white concretions of limestone, varying in size from half an inch to four inches in diameter. It varies much in color, however, depending upon the amount of ferruginous matter contained in it. In the southern and southeastern portions of Kansas and Nebraska this deposit is quite largely developed, often concealing the older rocks over large areas. According to Prof. Swallow it is seen throughout that portion of the State of Missouri bordering upon the river, but reaches its highest development from the Iowa line to Booneville. From thence to St. Louis it is very thinly represented. It is also largely developed in those portions of Kansas, Nebraska, and Iowa, which border upon the Missouri river, but attains its greatest thickness between Council bluffs and Sioux city, on the Iowa side. There it is two hundred and fifty to three hundred feet in thickness, forming a range of very precipitous hills, which are so steep that vegetation is with great difficulty supported on their sides. After passing the Big Sioux this deposit begins gradually to thin out upon the summits of the hills, and after passing the mouth of the Niobrara, it cannot be said to exert much influence on the surface of the country. It is observed, however, in outliers even to the mountains, both along the Missouri and Yellowstone rivers, is quite conspicuous near the mouth of the Judith, with a thickness of one hundred feet, and containing its peculiar fossils. Wherever it occurs in the interior of the country it may be readily recognized by the more luxuriant and healthy vegetation which it supports.

About three miles above Florence the marl bluffs are cut by the waters of the Missouri so as to present the following section:

	Feet.
1. Yellow silicious marl, homogeneous in its character, containing numerous white calcareous concretions, varying in size from half an inch to several inches in diameter,	100 to 150
2. Yellowish sand and clay, very ferruginous, containing rounded pebbles sometimes forming a conglomerate,	3
3. Dark ash-colored clay, with a slight mixture of sand filled with small waterworn pebbles, usually of small size, seldom more than one inch in diameter,	2

Near the mouth of the Big Sioux there is a vertical section of the yellow marl similar to the above. All the southeastern portion of Nebraska is covered with a greater or less

thickness of this deposit, which extends a considerable distance up the Platte, Loup fork, and Niobrara rivers, and passes imperceptibly down into the Pliocene grits, which have revealed so many extinct mammalian remains. That a large portion of this formation is synchronous in age with what we have in this chapter termed the Drift deposit I have no doubt. A great thickness of waterworn pebbles often underlies the yellow marl, and the two deposits seem often to pass into each other by almost imperceptible gradations. Indeed, in many places the drift beds vary very greatly in thickness, and at others alternating with the marl, proving quite clearly that there is a distinct geographical difference in the character of the deposit, rather than a difference of age.

The fossils peculiar to the yellow marl deposit are quite numerous in species. Mingled with the remains of most of the living mammals of the plains are those of extinct quadrupeds, as *Mastodon*, *Elephant*, &c., with large quantities of fluviatile and terrestrial molluscs of the genera *Helix*, *Limnea*, *Physa*, *Paludina*, *Pupa*, *Planorbis*, *Succinea*, *Amnicola*, *Cyclas*, &c., for the most part identical with species living in the vicinity at the present time. One species, *Succinea lineata* (W. G. Binney), was first found fossil in the marl, but has since been procured in a living state from around some small lakes in the sandhills on Loup fork. Others will doubtless yet be found living when the living molluscous fauna of the Upper Missouri is more thoroughly investigated.

3*d*. *Erratic Block Deposit.*

I have given this name to a superficial deposit of rocks or boulders, which forms quite a conspicuous feature in many portions of the Northwest. It is formed of nearly or quite unworn rocks from all the formations in that country, but more especially from the metamorphic and palæozoic series. That it is more recent than the two deposits already alluded to is evident from the fact that it overlies them both wherever they are exposed. It seems to be very similar in its character, though on a much smaller scale, to that of the "Erratics" of New England, but the rocky masses are not usually so large, seldom exceeding four or five tons in weight. These rocks are far more numerous on the north side of the Missouri river, thinning out and becoming smaller in a southwesterly direction until they entirely disappear. But on the north side of the river, in Dakota and Minnesota, the whole surface of the country may be said to be covered to a greater or less extent with these erratic blocks. The hills that border the river opposite Fort Pierre are paved with them for miles, so that a person could step from block to block. Sometimes they form zones or belts with a southeasterly and northwesterly range. Near Fort Pierre these belts are from half a mile to a mile in width, on the surface of which are scattered very thickly these angular masses, while an intervening belt of land occurs whose surface is nearly destitute

of rocks. This exceedingly curious feature in the country was often pointed out to me as a mystery by the voyagers as we ascended and descended the river. The same phenomenon occurs on Pratt's creek, about fifteen miles below Bijoux hills, though on a much smaller scale, consisting of a series of local belts of land either entirely destitute or wholly covered with angular or slightly worn rocks. We have, first, a belt 15 or 20 yards wide, covered very thickly with erratic blocks; second, an interval of 150 yards almost free from rocks; third, a belt of rocks similar to the first, and so continues for several miles. These alternate belts occupy a large area in this region, having a northwest and southeast range, and show conclusively the source from whence these rocks were derived as well as the agency which transported them from their parent bed. Bijoux hills, which are from 500 to 700 feet high above the bed of the Missouri, are covered with "erratics," many of which are masses of limestone containing fossils, as *Trilobites, Crinoids, Corals,* and *Brachiopoda* of palæozoic types. The above facts show clearly the great interest which surrounds this subject, and that it is well worthy of a careful investigation.

4th. Bottom Prairie.

The broad fertile bottom prairies of the Missouri are included in the above division of the superficial deposits, and constitute a most interesting geological feature. These bottom prairies form by far the most fertile lands of the West, the vegetable soil sometimes extending downwards to the depth of twenty or thirty feet, and covered with tall sedge grass and flowering plants, with here and there a grove of gigantic cottonwood trees. These bottom lands are quite extensive along the Missouri from the mouth of the Kansas river to Council bluffs, but attain their greatest width between Council bluffs and Sioux city. On the Iowa side of the river the bottom seems to be continuous for one hundred miles, varying in width from five to thirty miles. The Vermilion prairie commences at the mouth of the Big Sioux and extends with very little interruption to Dorion's hills, a distance of sixty miles, and varies in width from one to eight or ten miles. The materials which compose the Bottom Prairies seem to have been derived to a great extent from the calcareous and silicious marls of the Tertiary, mingled with the clays of the Cretaceous strata of the Upper Missouri, and the surface is covered with a thick vegetable mould, from the annual decay of an enormous growth of vegetation.

5th. Alluvium.

The distinction between Alluvium and Bottom Prairie is very marked all along the Missouri river. It is quite evident that the latter, as restricted in the previous division of the Quaternary deposit, could not have been formed by any agencies in operation at the

present day, while the former is subject to change from year to year and even from day to day. The channel of the Missouri is continually changing from side to side, wearing away and removing alluvium, bottom prairie, or any other formation with which the current may come in contact. The materials are held in suspension in the waters and are carried down the stream to form sandbars, islands, &c. Most of the islands which so thickly dot the bed of the Missouri and much of the timber portions along the side of the river are formed of alluvium. When the main current of the water changes from one side of the bed to the other a sandbar is formed immediately, a thick growth of willows springs up, which is soon succeeded by cottonwood, which may become a fine forest before the current brings its eroding power again to bear upon it. Near the mouth of the Platte there is an island, called Pilot island, formed about fifteen years ago by the wreck of a steamer on a sandbar. The loose materials commenced accumulating upon the upper side of the broken ship, and at the present time the island covers an area of several acres with a thick growth of cottonwood trees from twelve to twenty inches in diameter. The Missouri, as well as all its tributaries, furnish countless examples of this deposit, but the land thus formed is so subject to removal that it is of comparatively little economical value to the settler farther than to furnish a moderate supply of timber. The disadvantages arising from their want of permanence are too well known to be mentioned in this connection.

I have thus presented a mere outline of my notes on the superficial deposits of the Northwest, with the view of developing the subject more fully in my future investigations. Surface geology has not yet received that attention which its importance demands, and it seems quite obvious that a clear understanding of the forces now in operation will be found to be of the highest importance in explaining the geological phenomena of the past.

River Terraces.

So well marked a feature of the valley of the Missouri and its tributaries as the river terraces should not be passed over in this connection without a brief notice. I will not at this time attempt to account for their existence, but content myself with stating a few of my observations.

All along the valley of the Missouri river, from mouth to source, these terraces are more or less conspicuous, and they are also seen in the valley of every important tributary. These phenomena are not, however, confined to the Northwest alone, but are observed to a greater or less extent all over the western portion of the continent, and such is their similarity of character, that it points to some uniform cause for their existence. In Prof. Dana's great work forming one of the Reports of the Exploring Expedition series, the subject is treated very fully from observations made by the author along the western

slope of the Rocky Mountains, and as they all indicate these western slope terraces to belong to the same great system, the remarks that will apply to one portion of the country will apply to a greater or less extent to all.

Near the sources of the larger streams as they flow from the steep sides of the mountains, these terraces form a very conspicuous feature of the valleys. There are usually from three to four of them, forming quite narrow benches, and gradually increasing in width but diminishing in height as we approach the Mississippi. For example, in the valleys of the three forks of the Missouri, there are three and four of these terraces on each side of the river-bed; first terrace near the channel of the river, three feet above water-level, varying in width from a few feet to ten or twenty yards; second terrace ten to twenty feet above the bed of the river, from ten to fifty yards wide; third terrace thirty to fifty feet high, and from twenty to forty yards wide; fourth terrace one hundred to one hundred and fifty feet high, and varying from one hundred yards to half a mile in width. As we descend the Missouri, the fourth terrace seems to be wanting, and the first, second, and third terraces vary greatly in width, often forming broad, level, plains. Near the mouth of the Yellowstone, the first terrace is from three to six feet above the water, and is on a level with the islands and sandbanks. Most of the timber grows upon this terrace; the second terrace forms what is called the bottom, and is from ten to fifteen feet in height, and from a few yards to half a mile in width; and the third terrace ascends very gradually to the foot of the bluffs, varying from one mile to five miles in width, and twenty to forty feet in height. Upon this terrace Fort Union is built, and it has never yet been known to be overflowed. It is covered with a thick deposit of marl, underlaid with small waterworn pebbles, generally to the depth of from ten to twenty feet, and then we come to the Tertiary beds. The first and second terraces are in most cases composed entirely of the more recent superficial deposits. Along the valley of the Big Shyenne and near the Black hills, we again see these terraces, forming very broad, level, beautiful plains. Near the mouth of Plum creek, the first terrace is a fine grassy bench about four feet above the bed of the stream, and the second terrace is fifteen to twenty feet in height, and the third forty to fifty feet high. This last terrace is covered with a thick deposit of pebble-stones, sand, and gravel, resting upon Cretaceous formation No. 4, which is the prevailing rock of this region. Near Fort Randall, the first terrace is composed of fine sand, clay, and pebbles, six to ten feet above the river; second terrace, stratified sand and clay, from ten to twenty feet high; third terrace is composed mostly of dark stratified indurated clay, with numerous seams of pebble-stones. It is evidently derived from the eroded materials of Cretaceous formation No. 4, and at one point forms a series of bluffs sixty feet in height, worn into ravines like bluffs on a larger scale. As we approach the settled portions in descending the Missouri, we find that most of the towns and villages

are located upon the third terrace, which is far above high water mark. Near Bellevue and Omaha city we have very fine examples of terraces, and these villages are located upon the third. In a forthcoming official report I hope to treat this subject in detail, illustrating it with numerous outline sketches. We regard this subject as one of great interest, and most intimately connected with the history of the elevation of the western portion of the continent, for we can hardly doubt that the terraces result from the gradual elevation of the Rocky mountain range.

CHAPTER XIII.

Resume of the Geology of the Missouri River and its Tributaries.

In the following chapter I desire to present a *résumé* of the geology of that portion of the Northwest under consideration, with the additional information obtained since the preceding report was written. The foregoing chapters, with very slight alterations, remain as they were prepared over two years since, inasmuch as I have not felt authorized to make any important changes on account of my relations to a subsequent expedition to the Northwest, under the command of Captain Wm. F. Reynolds, T. E., a report of which exploration is now in a state of preparation. By permission of Captain Reynolds, a summary of the principal geological results was published, which is now before the world, and from it and from other sources I hope to make a condensed statement of the leading geological discoveries up to the present time, and to harmonize some of the conflicting opinions which may have been advanced in regard to the age of the different deposits in the West. Opinions differing widely from those which Mr. Meek and the writer have advanced, derived from the personal observations of the latter, and our joint investigations of extensive collections of organic remains, have been put forth by a writer who never visited the country explored by me, which may have had a tendency in some minds to weaken the force of our statements. Without entering into any discussions I would simply say, that all of my statements have been made with a conscientious regard for the truth, and such conclusions have been derived as seemed legitimate, leaving to the future to correct that which is wrong and approve that which is right. I cannot feel satisfied, however, to have any geologist, after a brief exploration and even without any personal knowledge of the country, pronounce my observations, which have been made with great care and patience, through the toil of many years, as entirely at variance with the truth.

We may very properly separate the western portion of our continent into two divisions, mountain and prairie, and a combination of the two will form the Rocky mountain district.

This district may be said to commence as soon as we leave the Mississippi westward, the ascent being gradual but continually on the increase until we arrive at the foot of the mountains. Leaving St. Louis westward we gradually ascend, passing over a prairie region for the most part, for the distance of nearly 800 miles, when we have reached an elevation of 6000 feet and come abruptly to the lofty rugged mountain peaks which compose the upheaved ridges. To illustrate this statement, let us examine the profiles across the country from the Mississippi westward, which have been constructed by the War Department. Glancing at the general map of the country west of the Mississippi, also published by the War Department, we will observe that the immediate Rocky mountain region is not composed of merely a single lofty upheaved ridge extending across the continent, but a vast series of ridges or ranges, which taken individually do not seem to have any definite trend, but when viewed in the aggregate extend across the map in a direction nearly northwest and southeast, forming a zone or belt 500 to 1000 miles in width from east to west. From long. 96° westward to the foot of the mountain ridges the country traversed exhibits the true typical prairie, no timber being found to any extent, except that which skirts the streams. From thence to the Pacific coast we have what may be called the true mountain portion, which is composed of a vast number of ridges of elevation, interspersed with beautiful valleys, many of which are remarkable for their fertility. Some of the valleys are quite large and are surrounded by mountain ridges as by gigantic walls.

If we look at the barometrical profile constructed by Gov. Stevens, from St. Paul's, Minnesota, to the foot of the mountains westward, we find that the former locality is 828 feet above the sea. Near the mouth of the Yellowstone, 670 miles to the westward, we find that the elevation is 2010 feet above the sea, and that we have made a gradual ascent in that distance of 1172 feet. As we approach the base of the mountain ridges the ascent continues to increase, and when we reach the valley of Dearborn river, 448 miles farther west, we ascertain that this locality is 4091 feet above the sea level, and that in that distance of 448 miles we have ascended 2081 feet, or nearly 5 feet to the mile. The valley of Dearborn river is just at the foot of the mountains, and to that point the country traversed belongs to the true type of the western prairie.

Again, if we examine the profile commencing at Council bluffs on the Missouri river, we find the elevation at that point to be 1327 feet above the sea level. Thence proceeding westward to the sources of Lodge Pole creek, at the base of the Laramie range of mountains, we have made an ascent, while thus passing over the prairie region, of nearly 5000 feet. We thus see that in the distance of 550 miles we have reached an elevation 3000 feet higher than our starting point, by an ascent of 5 feet to the mile.

Again glancing at the profile extending from Fort Leavenworth westward, we observe that at the Missouri river the elevation is 904 feet above the sea. At the base of the Laramie

range of mountains, 659 miles west, the elevation is 6716 feet. To show the increased rapidity of ascent as we approach the vicinity of the upheaved ridges, we see that the elevation at the forks of the Platte is 3000 feet above the sea, making an ascent from the Missouri river to this point, a distance of 413 miles, of 2096 feet, or about 5 feet to the mile. From the forks of the Platte to the foot of the Laramie mountains, a distance of 413 miles, we find an increased elevation of 3716 feet, or 15 feet to the mile. After reaching the base of the elevated ridges, the ascent is more or less abrupt, sometimes rising to the height of 3000 to 6000 feet above the open prairie country around. We might give many more illustrations similar to those just stated, extending them over to the Pacific coast, but we reserve them for a future occasion. We have said enough, however, to indicate the beautiful unity in the physical development of the western portion of our continent. With the above brief outline of a subject which I hope to pursue much farther at some future time, I proceed to consider the geological structure of the mountain chains.

We may at once make the statement, that there appears to be two types of mountain elevations, namely, those elevations which have a granite nucleus and form long continuous lines of fracture with far less irregularity of outline, and those ranges which are composed of erupted rocks, which are very rugged in their outline and irregular in their trend. We will in the first place examine the Black hills as an illustration of the first type, which is the most eastern outline of the main mountain range. Very little was known of these mountains until they were explored in the summer of 1857, by an expedition placed by the War Department under the command of Lieut. G. K. Warren, T. E., U. S. A., to which expedition the writer was attached as geologist and naturalist. A preliminary report of the results of this exploration was presented to the War Department under the title of "Explorations in Nebraska and Dakota, in the years 1855, 6, and 7."

The Black hills lie between the 43d and 45th degrees of latitude, and the 103d and 104th degrees of longitude, and occupy an area about 80 miles in length, and from 30 to 50 miles in width. According to Lieut. Warren, the shape of the mass is elliptical, and the major axis trends about 20° west of north. The base of these hills is about 2500 to 3000 feet above the sea, and the highest peaks 6700 feet above the ocean. The whole range is clasped, as it were, by the north and south branches of the Big Shyenne river, the most important stream in this region. The north branch passes along the northern side of the range, receiving very many of its tributaries and most of its waters from it, but takes its rise far to the westward of the range, near the sources of Powder river, in the "divide" between the waters of the Yellowstone and those of the Missouri.

The south fork also rises in the same divide, flowing along the southern base of the range, and also receives numerous tributaries which have their sources in it. These two

main branches unite about thirty miles east of the Black hills, forming the Big Shyenne, which empties into the Missouri about sixty miles above Fort Pierre. The Moreau, Grand, Cannon-ball, and other rivers flowing into the Missouri north of the Shyenne and south of the Yellowstone, rise in a high Tertiary divide north of the Black hills, and are for the greater part of the season quite shallow and sometimes nearly dry, but the Little Missouri derives a portion of its waters from the Black hills through a number of small branches which flow from the northwestern slope.

We thus see that the Black hills do not give rise directly to any important stream, if we except the Little Missouri, a few branches of which flow from springs near the base of the hills, but afford a comparatively small supply of water from that source. The Shyenne is fed for the most part from the numerous small streams which issue from copious springs in the more elevated portions. It would seem, therefore, that the Black hills do not have a marked influence upon the drainage of this region.

I have already noticed the geological structure of the Black hills, but will state briefly its principal points. The nucleus or central portion is composed of a red feldspathic granite with a series of metamorphic slates and schists superimposed, and thence upon each side of the axis of elevation the various fossiliferous formations of this region follow in their order to the summits of the Cretaceous, the whole inclining against the granitoid rocks at a greater or less angle. From the above facts we draw the inference that prior to the elevation of the Black hills, which must have occurred after the deposition of the Cretaceous rocks, all these formations presented an unbroken continuity over the whole area occupied by these mountains. This is an important conclusion, and we will hereafter see its application to other ranges, and also to the Rocky mountain range taken in the aggregate.

Proceeding in a southwest direction from the Black hills along the anticlinal, we see ample evidences of the connection of these hills with the Laramie mountains. By the Laramie mountains we designate those eastern ranges which extend from the Red buttes southward to the Arkansas. This range when examined in detail is composed of a large number of smaller ranges, all, so far as I have observed, of the true granitic type. The trend of the whole group is very nearly north and south, northward as far as Fort Laramie, where they make an abrupt flexure around to the west and northwest, and gradually cease or die out at the Red buttes. From this point westward and northward, there is a space of from twenty to forty miles in width, destitute of mountain elevations, though the strata exhibit evidence of dislocation or crust movements.

Geologically the Laramie range is also composed of a granitoid nucleus, with the fossiliferous formations, Silurian, Carboniferous, Red Arenaceous beds, Jurassic, Cretaceous, and in many places Lignite Tertiary, inclining from each side of a central axis at various angles.

It is from these mountains that the numerous branches of the Platte have their sources, extending a distance of nearly four hundred miles. Again, the dynamical structure of this range warrants the inference that these rocks, in a more or less horizontal position, were continuous over the whole area at present occupied by it some time during the Tertiary period.

The minerals of economical value are quite extensive. The gold mines of Pike's Peak are in this range, and the evidence is quite conclusive that this precious metal will be found to a greater or less extent all along the eastern slope. Iron ore is found in great abundance and of the best quality, while along the North Platte and in the vicinity of Pike's Peak, lignite is known to exist in considerable quantities, and has been used for fuel.

The most important outlier of the Rocky mountains, on the eastern slope, is the Big Horn range, which, though somewhat irregular in the shape of its mass, has a general trend nearly northwest and southeast. It occupies an area about 180 miles in length and 50 in breadth. Near latitude 43½° and longitude 102° the line of fracture seems to have ceased toward the south or southeast and to have made a gradual flexure around to the west, the whole range soon losing its granitoid character and becoming entirely composed of more modern eruptive rocks. The eruptive portion continues westward until it joins on to the Wind river range near the sources of Wind river. At the southern end of the Big Horn mountains, we can trace a single low anticlinal across the prairie, connecting these mountains with the Laramie range at Red buttes on the North Platte. We also know by the position of the fossiliferous strata upheaved along the mountains, that the gradual flexure of the range to the west joins on to the eruptive portion, and thus forms a connection with the Wind river range.

The central portion of these mountains is also composed of granite and granitoid rocks, with the same series of fossiliferous formations, inclining at various angles from each side of the axis of elevation, as are seen around the Black hills and along the Laramie mountains. Some of the more lofty peaks are from 8000 to 12,000 feet above the sea, and are clothed with perpetual snow. We think that the evidence is quite clear that up to the time of the accumulation of a large portion of the Lignite Tertiary beds, all these formations, from the Silurian to the true Lignite strata inclusive, were in a horizontal position, extending continuously over the whole area occupied by the mountains, but as they were slowly elevated, the central portions were removed by the erosive action of atmospheric agencies. The eruptive portion which unites the Big Horn range with the Wind river mountains is exceedingly picturesque, presenting the appearance of a connected series of basaltic cones, and so rugged and inaccessible are they that the persevering trappers have never been able to penetrate them in their hunting explorations.

Like the Black hills, the Big Horn range does not give rise to many important sub-

hydrographical basins. The largest stream in this region, and one which gives name to the mountains, rises in the Wind river range, passes through the Big Horn mountains, and unites with the Yellowstone about seventy miles to the southward. Before reaching the mountains it takes the name of Wind river, and assumes the name of Big Horn after emerging from them. This range, however, constitutes quite an important feeder to the Yellowstone. Powder river, which rises in this range by numerous branches, drains a large area, mostly Lignite Tertiary, and pours a considerable volume of water into the Yellowstone, near lon. 105½° and lat. 46½°. Tongue river is the next most important stream, which, though not draining so great an area as Powder river, empties into the Yellowstone a much larger bulk of water.

The Medicine Bow and Sweet Water mountains appear to be of the same character, for the most part; but on the east side of the Sweet Water river the evidence of igneous action is shown on a large scale. The ancient volcanic material would seem to have been elevated to a great height in but a partially fluid condition and then to have gradually cooled, affecting to a greater or less extent the fossiliferous strata in contact.

Near the junction of the Popo Agie with Wind river, we come in full view of the Wind River mountains, which form the dividing crest of the continent, the streams on the one side flowing into the Atlantic, and those on the other into the Pacific. This range is also composed to a large extent of red and gray feldspathic granite, with the fossiliferous rocks inclining high upon its sides. After passing the sources of Wind river, the mountains appear to be composed entirely of eruptive rocks. Even the three Tetons, which raise their summits eleven thousand feet above the ocean level are formed of very compact basaltic rock. The Wasatch and Green River ranges, where we observed them, have the same igneous origin, and the mountains all along the sources of the different branches of the Columbia exhibit these rocks in their full force. In Pierre's hole, Jackson's hole, and other valleys surrounded by upheaved ridges, these ancient volcanic rocks seem to have been poured out over the country and to have cooled in layers, giving to vast thicknesses of the rocks the appearance of stratified beds.

The mountains about the sources of the Missouri and Yellowstone rivers are of eruptive origin and in the valley of the Madison fork of the Missouri are vertical walls of these ancient volcanic rocks one thousand to fifteen hundred feet in height, exhibiting the appearance of regularly stratified deposits dipping at a considerable angle. As we pass down the Madison we find some beds of feldspathic rocks and mica and clay slates beneath the eruptive layers, dipping at the same angle. After passing the divide below the three forks of the Missouri we see a number of partially detached ranges, which appear to be of the same igneous character. In the Belt, Highwood mountains, and indeed all along the eastern slope in this region, we find continual evidence of the outpouring of the fluid ma-

terial in the form of surface beds or in layers thrust between the fossiliferous strata. These igneous beds thin out rapidly as we recede from the point of effusion. A large number of these centres of protrusion may be seen along the slope of the mountains west of the Judith range. The erupted material sometimes presents a vertical wall three hundred feet high, then suddenly thins out and disappears. The Judith, Bear's Paw, and Little Rocky mountains seem to be composed for the most part of granite and other rocks, with igneous protrusions here and there. I have in a former paper expressed the opinion that the central portions of our mountain ranges are composed of feldspathic granite, and to a certain extent this is true in regard to the more eastern outliers, but more recent observations have convinced me that these rocks, which I have defined by the term eruptive, compose by far the greater portion of the mountain masses of the West.

We have already alluded to the fact that the Potsdam sandstone in its western extension, was first made known as occurring in the Black hills. It here rests upon the upturned or nearly vertical edges of the schists, clay slates, and granitoid rocks, and the inference was drawn that the same rock would be found forming an outcropping belt all along the eastern slope of the Rocky mountains. Subsequent explorations have shown that it also occurs along the margins of the Big Horn range, near the summit, holding the same relative position, and exhibiting the same lithological characters. A few thin layers of fine calcareous sandstone were observed, filled with fossils characteristic of this period. At the head of La Bonte creek in the Laramie range, I noticed a bed resting discordantly upon azoic slates, fifty to one hundred feet in thickness, holding the same position and possessing the same lithological characters which it reveals at other localities. I could discover no fossils in it at this point, but I am confident that this bed represents the Potsdam sandstone. The same bed seems to occur all along the mountains from Laramie peak to Cache la Poudre creek, underlying the well-known Carboniferous strata, and resting upon the decomposing granitoid rocks, which form the nucleus of the first or lower ridge. This rock (the Potsdam) is more or less changed by heat from beneath, but I was able to trace it continuously from the source of the Chugwater creek to the source of Cache la Poudre, a distance of over one hundred miles. It was also seen along the eastern slope of the Wind River mountains, but did not contain any organic remains.

The above facts show very clearly that in its western extension, the primordial zone of Barrande is represented only by a thin bed of sandstone, never exceeding one hundred and fifty feet in thickness, and that is seen only in a very narrow outcropping belt near the margins of the mountain crests. The stratified azoic rocks upon which it rests discordantly, so far as my observations have extended, never reach a very great thickness in the West.

On both sides of the divide of the Rocky mountains, so far as our explorations have ex-

tended, a series of calcareous, areno-calcareous, and arenaceous beds are seen, which we have referred to the Carboniferous epoch. They vary in thickness at different points. Without specifying localities, it will be sufficient to remark, that all along the margins of any of the mountain elevations in the far West, these rocks are seen in a more or less inclined position.

Sometimes they are not visible for a short distance (as between the Laramie and Platte rivers, twenty or thirty miles), but it is plain that they have either been removed by erosion, or concealed by more recent deposits. Along the Big Horn mountains there are alternate layers of sandstone, arenaceous and magnesian limestones, many of which show oblique laminæ and other indications that their deposition took place in shallow and perhaps turbulent waters. They are here developed to a thickness of one thousand to fifteen hundred feet, and incline high upon the sides of the mountains, at an angle of 50° to 70°. They contain few fossils, but these indicate rocks of the same age as those in the Black hills. Along the Laramie mountains, from the Red buttes to Pike's peak, apparently the same limestones are seen inclining against the sides of the elevated ridges, at greater or less angles; and on the opposite side of the axis sloping down to the Laramie plains, the corresponding strata are seen, though leaning at much smaller angles, usually from 9° to 15°. Along the Sweet-water and Wind River mountains, these rocks are highly developed, and incline against the sides of the ridges of elevation as heretofore described. The corresponding portions are also seen on the west slope of the main range, at the sources of Green and Snake rivers, but not as conspicuously developed, the eruptive rocks predominating. Crossing back over the dividing crest, near the sources of the Madison, Jefferson, and Gallatin forks of the Missouri, we find similar limestones largely developed, and covering a considerable area on the eastern slope. Near the junction of the three forks, and along Smith's or Kamas river, we find them reaching a thickness of eight hundred to one thousand feet, often partially changed by contact with igneous rocks beneath. They were also observed around the Judith mountains, and also about the Bear's paw and Little Rocky mountains.

Nowhere in the Rocky mountain range, so far as my observations have extended, do the Carboniferous rocks seem to abound in organic remains, and the few usually seen are generally found in a bad state of preservation, and comprise a limited number of species. The precise period to which these rocks belong, which are so persistent in all disturbed regions, is not positively known, the evidence from organic remains pointing to the age of the Coal measures, and sometimes to that of the Lower Carboniferous period; probably both members of the system occur there.

At the foot of the Big Horn mountains, near the head of Powder river, I observed at one locality a series of beds which indicated the presence of Permian rocks. These beds,

which are composed of cherty magnesian limestone, are very much like those already described in Northeastern Kansas, and contain in great abundance some of the same species of fossils, as *Myalina perattenuata*, and others. I have also seen similar limestones in other localities, but no fossils were detected, and though having a Permian appearance, they may belong to the upper portion of the Carboniferous.

The evidence is clear in many localities, that prior to the deposition of the Red Marls succeeding the supposed Permian, a very great erosion of the surface of the Carboniferous rocks took place. We find, for example, in many localities only a thin representation of the Carboniferous rocks, and again a full development, one thousand to fifteen hundred feet in thickness.

Overlying the Carboniferous rocks and equally persistent with them is a series of red arenaceous marl beds or gypsum-bearing marls, which are co-extensive with the upheaved sedimentary formations along the Rocky mountains. The largest development of these beds which I have observed, occurs on the northeastern side of the Big Horn mountains, and on the west slope of the Wind River mountains, near the source of the Gros Ventres fork of Snake river. From the Red buttes on the North Platte to Pike's Peak these beds are often removed by erosion or concealed by superficial deposits, but their appearance in numerous places shows very clearly that beneath the surface they occupy a considerable area throughout the country bordering the mountain ranges, possibly extending entirely over the eastern slope. Passing over into the Laramie plains we find that the red marls constitute the surface formation of the plain country. It has also been shown from the investigations of Messrs. Meek and Engelmann, that these beds are revealed along the Wasatch mountains, even south of Lake Utah, furnishing undoubted evidence that they belong to the same great deposit. The fact also that one thousand to fifteen hundred feet of red arenaceous beds are seen near the sources of Green river, leads to the inference that they continue southward far down the Green river valley to that portion which takes the name of Colorado, and are in fact a continuation of the extensive red deposits, described by various explorers in New Mexico.

These red beds are also seen under similar circumstances highly developed along the mountains at the sources of the Missouri. There seems to be a change in the lithological characters below the Gate of the mountains, the peculiar red deposits disappearing for the most part, and a series of irregular layers of silicious limestone with a reddish tinge, and with oblique laminæ, ripple-mark and other indications of shallow water deposition. It is through these layers of rock that the Missouri river cuts its way from the foot of the mountains to the mouth of Highwood creek, about ten miles below the falls. They are also distinctly revealed around the Judith mountains. Along the Big Horn mountains thick layers of gypsum occur, but the gypsum beds are by no means co-extensive with the red deposits, and indeed are present in but few localities. Near the head of Powder river

the aggregate thickness of the gypsum strata is about one hundred feet, while near the source of Snake river there is a thickness from fifty to eighty feet. It also occurs to a considerable extent at the foot of the mountains, on La Bonte creek, a branch of the North Platte.

At the time of writing the preceding report, no division had been made of the red beds separate from the Jurassic, because at that time there was no proof that they were distinct, no organic remains having been obtained from them. We only knew that they held a position below the well-established Jurassic rocks, and that, so far as had been observed, there was no physical break in the sequence of the strata. These red beds, however, when compared with similar red rocks in the Old World, had been often referred to the age of the Triassic or New Red Sandstone. The explorations of Dr. Newberry in New Mexico revealed quite a number of species of plants and the bones of a large saurian animal which seem to direct his mind toward the Triassic epoch. The plants discovered by Dr. Newberry in New Mexico were referred by him to the genera *Zamites*, *Pterophyllum*, &c., and regarded as similar to those of the Keuper (Upper Trias) of Europe. Though the evidence so far obtained points quite strongly toward the Triassic epoch, it is not yet considered sufficiently clear to warrant a positive opinion in regard to their age. If these red arenaceous deposits really represent a distinct geological epoch, it seems quite strange that they have as yet yielded so few organic remains. They have already been examined with considerable care over an area, in the vicinity of the Rocky mountains, extending from latitude 49° far southward into New Mexico. On the west side of the Wind River mountains we have discovered fossils beneath the red beds, which may include those in the Jurassic.

The Jurassic rocks are everywhere revealed overlying the red deposits just mentioned, and possess an equal geographical extension.

Their fullest development and most fossiliferous condition seems to be along the margins of the Black hills, where they have furnished the most satisfactory evidence of their age. Along the northeastern slope of the Big Horn mountains, this group of rocks presents its usual appearance of gray and whitish calcareous and arenaceous layers, with indurated somewhat variegated beds of more or less laminated marls, containing in great abundance *Belemnites densus*, *Pentacrinus asteriscus*, a new species of *Ostrea*, *Pecten*, &c.

At Red buttes we find a fair development of these beds with the same fossils, but as we proceed southward toward Long's Peak, the intercalated laminated marls disappear, and the whole formation seems to be reduced to a thickness of fifty to one hundred feet, with very few fossils. Along the southwest side of the Big Horn mountains and the northeast side of the Wind River mountains we have a thickness of Jurassic rocks from eight hundred to one thousand feet, containing organic remains in the greatest abundance. Crossing the Wind River mountains we observed the strata corresponding to those upon the eastern side with *Belemnites densus*, *Ostrea*, &c. Returning to the eastern slope at the sources of

the Missouri we see occasional indications of their existence, but not so conspicuous as to be readily identified. The age of this group of rocks may be now considered as thoroughly established, so great a number of fossils which appear to be of undoubted Jurassic types have been obtained.

I have remarked that the older fossiliferous beds doubtless pass beneath the more recent Cretaceous and Tertiary deposits, and occupy a greater or less area underneath the prairie country east of the "divide" of the Rocky mountains. I have made this inference from the fact that where any elevations occur the complete series of fossiliferous beds are exposed around the axis of upheaval. For the benefit of those geologists who may be constructing geological maps of this portion of the West, I would say, that I have never seen any of the older fossiliferous rocks, from the Potsdam to the Jurassic inclusive, exposed, except in narrow outcropping belts around the margins of the mountain elevations. The Carboniferous rocks occupy a belt from one to two miles wide, and the red arenaceous deposits are exposed over about the same area, while the Jurassic form a zone never more than one-fourth of a mile to three miles in width.

The following additional facts in regard to the Cretaceous rocks of the Upper Missouri were obtained during the last expedition to that region. I have preferred to allude briefly to them here, inasmuch as they will appear in detail in a forthcoming report.

The various subdivisions of the Cretaceous group in the West were observed at numerous localities. The strata in many places occupy large geographical areas, holding a horizontal position, in others forming a belt or zone of greater or less width around the mountain elevations. No. 1 is a well-marked and distinct division along the Missouri river from De Soto to a point above the mouth of the Big Sioux river in the eastern portions of Kansas and Nebraska and in the South and Southwest. But when we come into the vicinity of the mountain ranges in the Northwest its typical lithological characters are wanting, and apparently an increased development of No. 2 only is seen.* Along the Big Horn mountains, No. 2 is eight hundred to one thousand feet in thickness, composed of black plastic clay, with several layers of gray and yellowish calcareous sandstones, ten to fifty feet in thickness. Along the Laramie and Wind River mountains the same characters are shown. After leaving the Missouri near the mouth of the Niobrara river, No. 3 is never seen presenting its typical marly character. In the vicinity of the Black hills we saw a series of beds composed of alternate thin layers of arenaceous and argillaceous sediments, with *Ostrea congesta* and *Inoceramus problematicus*, which may possibly represent No. 3. Along the Big Horn mountains and from Red buttes to Cache la Poudre creek the same fossils were often found, and some other indications of its existence, but no well-marked typical beds

* We mean that the distinctive lithological characters of No. 1, as seen on the Missouri, do not appear along the mountain elevations. It is probable that Nos. 1 and 2 are merged into each other, and lithologically form one division. Further evidence is needed before we can speak positively in regard to this point.

were seen. It is now well known that *O. congesta* and *I. problematicus* range down into No. 2, so that No. 3 in the West and Southwest may give place to an increased development of No. 2. Nos. 4 and 5 are largely developed everywhere, when not concealed by the overlying Tertiary deposits, especially along the Laramie mountains and in the valley of Cache la Poudre. In the valley of Wind river all the Cretaceous rocks down to No. 2 appear to have been removed by erosion prior to the deposition of the Tertiary beds, and the characteristic fossils of No. 2 are quite abundant. As we pass over mountains, we have inclining against the western slope six to eight hundred feet of alternations of black plastic clays, arenaceous marls, and beds of sandstones and limestone, with a few seams of Carbonaceous matter passing up into calcareous and arenaceous compact rocks. In some arenaceous limestones near the middle of the series and extending upward, quite abundant fossils were observed, among them a large *Inoceramus*, two species of *Ostrea*, a large *Pinna*, four inches in length, a *Cardium*, and a number of undetermined species with fragments of silicified wood. The general dip of these rocks is about 20°. These well-marked Cretaceous beds pass up quite imperceptibly into an enormous thickness of Lignite Tertiary. Passing over the dividing crest to the head waters of the Missouri, we did not observe any indications of Cretaceous rocks until we had descended below the three forks, where we find traces left after erosion. They do not reveal themselves conspicuously until we arrive within twenty or thirty miles of Fort Benton, where the black plastic clay begins to overlap the Jurassic rocks with its characteristic fossils, and on reaching Fort Benton the plastic clay is quite homogeneous, and is developed to a thickness of eight hundred feet. As we proceed toward the mouth of the Judith river and near the Judith mountains we find quite thick beds of concretionary sandstone, which form the "Stone Walls," "Citadel," &c. It is from these beds that we have obtained a group of fossils which we have referred provisionally to No. 1, but which seem to be specifically distinct from all others in the West. It may be that when this group of beds, now referred to Nos. 1 and 2, comprising a thickness of fifteen hundred to two thousand feet in this region, are more carefully studied, that several subdivisions will be made, having equal importance with the others. During the past season our route led us along the "divide" between the Missouri and Yellowstone rivers south of the Judith mountains, so that we passed outside of any good exposures of No. 1, as well as beyond the limits of the estuary beds at the mouth of the Judith. We must await a more thorough and detailed exploration of this region before we can state with entire confidence the succession of the beds.

In describing the Tertiary deposits in the Northwest, I separated them into two divisions, but more recent investigation has added many new facts in regard to them, and rendered the following divisions necessary. 1st, Estuary deposits; 2d, True Lignite beds; 3d, Wind River valley deposits; 4th, White River Tertiary deposits.

The estuary deposits, of which the Judith basin may be regarded as the type, are quite

remarkable and of a most interesting character. Opinions of a somewhat conflicting nature have been entertained in regard to them, owing to the peculiar character of the organic remains, but recent observations have convinced me that they are all of Tertiary age, and that they are quite widely distributed throughout the far West. The lithological characters of the Judith deposit have already been sufficiently described, and it has yielded many important fossils. A thin series of beds is also found near the sources of the Moreau, Grand, and Cannon-ball rivers, and at the mouth of the Big Horn river we have a group of beds eight hundred to one thousand feet in thickness, with fossils of the same character as those occurring at the mouth of the Judith. The collections obtained by Mr. H. Engelmann, in Utah, while acting as geologist of Capt. Simpson's expedition, and subsequently investigated by Mr. Meek, have also established the existence of an estuary deposit of Tertiary age in the country bordering upon Green river,—scarcely less interesting than that of the Judith. These deposits pass up into the true lignite beds without any perceptible line of separation, gradually losing their estuary character, and ever after containing only land and freshwater shells. The lignite strata are chiefly remarkable for yielding in the greatest abundance finely preserved vegetable remains. A few fragments of leaves of Dicotyledonous trees and silicified wood, with very impure lignite beds, are formed in some of the estuary deposits, but no groups to indicate the great luxuriance of vegetation which must have existed during the accumulation of the lignite strata.

The geographical extension of the lignite deposits of the West is now a matter of the highest interest, and from what is already known, I am convinced that they will yet be found to cover a greater or less area on both sides of the main divide of the Rocky mountains, from the Arctic sea to the Isthmus of Darien. The estuary and lignite beds seem also to have partaken, equally with the older fossiliferous rocks, of the influence which elevated the mountain chains. Along the Laramie mountains, and from the Red buttes to the divide between Platte and Wind rivers, along the Big Horn mountains, the strata incline at very high angles, 40° to 80°, and in some instances are very nearly vertical. The true lignite strata seem to conform to the older fossiliferous rocks, and to have been disturbed by the same influences that elevated the mountain ranges in the vicinity. These Tertiary beds extend over all the plain country to the north and east of the Laramie mountains, far to the northward, beyond the limits of our explorations. Crossing the Wind River mountains, we find them largely developed high upon the western slope, dipping at a high angle, from the Wind River range on the one side, and the Wasatch and Green River mountains on the other.

Throughout the Wind river valley is a series of beds of great thickness, which seem to be intermediate in their character between the true lignite beds and the White river Tertiary deposits. We first observed them gently inclined near Willow springs on the North Platte, and thence westward toward the Sweet-water mountains, and near the divide be-

tween the North Platte and Wind river they reach a thickness of four hundred feet. From this divide, throughout the Wind river valley, they occupy the greater portion of the country, and though inclining in the same direction with the older strata, the beds do not dip more than 1° to 5°. They differ from the other deposits in the great predominance of arenaceous sediments, and in the absence of vegetable remains, but they contain fragments of turtles and numerous freshwater and land shells, of the genera *Helix*, *Planorbis*, *Vivipara*, &c. The entire thickness of these deposits may be estimated at from fifteen hundred to two thousand feet. From the fact that these deposits do not conform to the true lignite beds, and that detached portions are seen lying upon the sides of the mountains but slightly inclined, while the corresponding beds are shown in the valley below, we infer that they were accumulated long before the mountains were raised to their present height, or perhaps during the gradual process of elevation. This is especially shown at the upper end of the Wind river valley. Passing over the Wind River mountains, we again see them holding the same position on the western slope, and possessing the same lithological characters. While the lignite beds on the west side of the divide incline at a large angle, the more recent beds, although in some places occupying the very crest of the mountains, seldom incline more than three to five degrees.

The most interesting additional facts which we have obtained in regard to the White river Tertiary beds, are their geographical extension, and the evidence of their age in relation to the Lignite Tertiary deposits. We can now show beyond a doubt that the former must have been accumulated long since the latter. We have ascertained that they extend southward along the Laramie mountains to Willow springs, within ten miles of Cache la Poudre, that they also extend up the North Platte to the Box Elder creek, and even beyond are small outliers, showing that much has been removed by erosion. Passing over into the Laramie plains, we find at the source of the Box Elder, and extending over to the head of Bates's Fork, a large development of this Tertiary, and it also reaches far westward to the Medicine Bow mountains. We also know from the observations of Dr. Hines, that it occupies a considerable area among the Sweet-water mountains, extending over into the Green river valley. We have, along the North Platte, the overlapping of the White river beds upon the Lignite strata, thus affording the evidence of superposition for their relative age. The same fact was noticed between the north fork of the Shyenne and the head of Cherry creek, where beds of marl and limestone, containing *Planorbis*, *Limnea*, &c., the same as are seen in the Bad Lands proper, repose upon true Lignite Tertiary strata. Again, while the White river beds hold for the most part a horizontal position, those of the Lignite Tertiary are often much disturbed. Near the Black hills, the former seem to have been elevated to a considerable height by the upheaval of the mountains, but they do not, in any case, incline more than one degree, while north of the Black hills the lig-

nite beds dip five to ten degrees. Along the Platte I have seen the former inclining five degrees, especially on La Bonte creek, and about fifteen miles east of the mouth of that creek. Often the beds seem to have been raised up several hundred feet above their original position, without inclination, resting upon the upturned edges of the lignite beds, which we have before observed partook equally of the disturbing influences which have given so great an inclination to the older fossiliferous rocks. Along the Big Horn mountains and the North Platte the lignite beds sometimes incline from the foot of the mountains eighty degrees, and often the influence of the elevatory power has affected them far out into the plain country.

In the above accounts of the Tertiary deposits of the West, we have shown that the older members are clearly separable into four divisions, exclusive of the Pliocene deposits of the Niobrara. Let us examine the evidence in regard to the age of these deposits. If we study the upper portions of Cretaceous formation No. 5, when not removed by the erosive power of water to any great extent, we then observe, from the time we pass from No. 4 to No. 5, a gradual change in the sediments, and other indications of a slow approach to shallow water: arenaceous sediments begin to take the place of argillaceous, so that we have alternate thin layers of sand and clay, the sand continuing to increase until the upper part becomes a yellow, ferruginous, coarse sandstone, with most conspicuous examples of ripple-mark and oblique laminæ. As the waters of the Cretaceous sea were gradually receding, toward the Atlantic on the one side and toward the Pacific on the other, remnants were left, in the form of lakes, estuaries, &c., which now afford us the last indications of marine and brackish water deposits in the central portions of the West. In these deposits we have first a mingling of brackish and freshwater forms, gradually passing up to pure freshwater and terrestrial species, with no return to the marine condition again.

In the upper part of the Cretaceous formation No. 5, on the Moreau, we find the *Ostrea subtrigonalis*, and in the Judith deposits a form occurs in the greatest abundance which is undistinguishable from it.

We have also mentioned the fact that the fossils of the upper part of No. 5 seem to have existed upon the verge of the Tertiary period, that they sometimes present peculiar forms more closely allied to Tertiary types than Cretaceous, and were it not for the presence of the genera *Baculites*, *Ammonites*, *Inoceramus*, &c., which are everywhere supposed to have become extinct at the close of the Cretaceous epoch, we would be in doubt whether to pronounce them Tertiary or Cretaceous. These facts would seem to indicate a foreshadowing of the Tertiary era, and that the transition from one great period to the other was gradual and quiet, the change in the physical conditions being ultimately sufficient to destroy the Cretaceous fauna and bring into existence that of the Tertiary. Again, in numerous localities where No. 5 is fully developed and a large thickness of Tertiary de-

posits is superimposed, so that near some of the mountain elevations I have found it difficult to draw the line of separation, no apparent physical break occurring in the sediments.

Will not these statements go far to show that the estuary deposits ushered in the dawn of the Tertiary epoch, and induce the belief that they belong to the first part or Eocene period? This point is an important one to establish, on account of its bearing upon the history of the physical development of our western continent.

The estuary deposits soon lose their marine and brackish character and gradually pass up into the true Lignite strata, of purely freshwater origin, thence by a slight discordancy into the Wind river valley beds, which give evidence of being an intermediate deposit between the true Lignite and White river Tertiary beds. Then come the White river bone beds, which pass up into the Pliocene of the Niobrara by a slight physical break, and the latter are lost in the Yellow Marl or Loess deposits. I have estimated the entire thickness of Tertiary rocks in the Northwest at from five to six thousand feet, and their interest will be appreciated when I venture to suggest that by thorough investigation they will doubtless reveal, step by step, in a most remarkably clear manner, the history of the physical growth and development of the central portion of this continent. I shall treat this subject more fully in a future paper, and would refer to the forthcoming Report of Capt. Raynolds for the details of the facts sustaining my opinions.

We have no evidence, so far as I know, of long-continued deep-water deposits in the West, until far up in the Cretaceous period. If we examine the Potsdam sandstone we shall find that where it reaches its greatest force, the lower portion is composed of an aggregation of quartz pebbles cemented with silicious matter, and as we pass upward we find it arranged in thin layers, quite compact, with fucoidal markings, ripple-mark, &c. Everywhere are most abundant examples of oblique laminæ of deposit, and ripple- and wave-markings—evidences of shallow waters.

During the long period that elapsed between the deposition of the earliest part of the Silurian epoch and the commencement of the Carboniferous, we have reason to believe that dry land prevailed over a large portion of the West. The Carboniferous epoch commences with thin layers of arenaceous deposits, gradually passing up into homogeneous silicious and calcareous beds. The latter are never more than from twenty to fifty feet in thickness, and then the arenaceous sediments begin again to predominate, and all the proofs of shallow as well as turbulent waters are shown. We then pass up through the red arenaceous deposits and Jurassic beds, and find no rocks that indicate deep-water deposition. Cretaceous formation No. 1 commences in many places with a considerable thickness of an aggregation of water-worn pebbles, passing up into thin alternate layers of arenaceous and argillaceous sediments, with thick beds of sandstone with ripple-markings and oblique laminæ, then these indications gradually cease in No. 2, and through Nos. 2, 3

and 4, the sediments show that they were accumulated in comparatively deep and quiet waters. No. 2 is a black plastic clay, No. 3 gray marl, and No. 4 a dark indurated sometimes laminated clay, with many calcareous concretions. In No. 5 we gradually approach indications of shallow water, until dry land appears, as already stated.

It will not be possible at this time to mention in detail all the oscillations of surface and other physical changes to which we have reason for supposing the country was subjected during all these periods. It is sufficient for our present purpose to show that except during the middle Cretaceous epoch no long-continued periods of quiet water prevailed in these ancient western seas.

The evidence appears to me to point to the conclusion that a much milder climate prevailed throughout the western portions of our continent, during a greater part of the Tertiary period than that which exists in the same latitudes at the present time. The organic remains appear to indicate a subtropical climate, or one similar to that of our Gulf States. Near the close of the Cretaceous epoch the waters of the great Cretaceous sea receded toward the present position of the Atlantic on the one side and toward that of the Pacific on the other, leaving large areas in the central portions of the West, dry land. These areas were of course in close proximity to the sea, and comparatively but slightly elevated above the ocean waters. In regard to the Mollusca which have been found quite abundantly entombed in the Lignite-bearing strata, it is an interesting fact that the most nearly allied living representatives of many of these species are now found inhabiting the streams of Southern Africa, Asia, China and Siam, apparently indicating the existence of a tropical climate in these latitudes at as late a period as the Tertiary epoch.

Again, the luxuriance of the flora, which has been so perfectly preserved in the Lignite strata of the West, point to the same conclusion. It is true that until recently no forms have been found which belong exclusively to a tropical vegetation, but during our last expedition we obtained a species of true fan palm, very closely allied to *Sabal lamononis*, figured by Dr. Heer in his "Flora Tertiaria Helvetiæ." "The most northern limit of palms is that of *Chamærops palmetto*, in North America, in lat. 34°–36°, and of *Chamærops humilis* in Europe, near Nice, in 43°–44° N. lat."* The true palms of our present day are considered as having their native land within the tropics. That this or a similar condition of climate continued throughout the accumulation of the Wind river valley deposits may be inferred from their Molluscan remains, which are more nearly allied to tropical forms.

Again, we have in this region, as before mentioned, a vast area occupied by the Lignite-bearing strata. There are from thirty to fifty beds of Lignite, varying in thickness from

* Lindley's Vegetable Kingdom, p. 136.

one inch to seven feet. Over all this great district there are at the present time no large forests, no timber except that which skirts the streams. We now know that during the Tertiary period vast forests of timber must have covered many portions of the far West, from the abundance and variety of the vegetable remains preserved in the rocks. Silicified trunks of trees, fifty to one hundred feet in length and two to four feet in diameter, and stumps which indicate gigantic forest trees, occur abundantly over hundreds of square miles along the Missouri and Yellowstone rivers. Prof. Henry and other meteorologists have arrived at the conclusion, from a large number of well-authenticated facts, that the absence of forest trees on the great prairies of the far West is due to the want of moisture, which is well known to prevail all along the eastern slope of the Rocky mountains. The prevailing winds are now known to come from the west, and as the currents of air ladened with moisture from the Pacific ascend the western slope of the mountains, become condensed and deposit their burdens for the most part before reaching the eastern slope.

Prof. Henry, in his paper on Climatology, contributed to the Patent Office Report for 1856, says: "The return westerly current, sweeping over the Pacific Ocean, and consequently charged with moisture, will impinge on the Coast Range of mountains of Oregon and California, and, in ascending its slopes, deposit moisture on the western declivity, giving fertility and a healthful climate to a narrow strip of country bordering on the ocean, and sterility to the eastern slope. All the moisture, however, will not be deposited in the passage over the first range, but a portion will be precipitated on the western side of the next, until it reaches the eastern elevated ridge of the Rocky mountain system, when, we think, it will be nearly if not quite exhausted." We are now supposing that the climatic conditions—winds, currents of air, &c., did not differ to any great extent during the Tertiary epoch from those which prevail in the same latitudes at the present day. We therefore venture the suggestion that up to the time of the accumulation of the middle Tertiary deposits the lofty barrier of the Rocky mountains did not exist.

CHAPTER XIV.

MINERALS AND GEOLOGICAL SPECIMENS.

I. IGNEOUS AND METAMORPHIC ROCKS.

1. Gneiss ferruginous, . . . 12 m. N.W. Ft. Lar.
2. Mica slate, ... do. do.
3. Mica, more micaceous, . . . do. do.
4. Granite, coarse, ... Laramie peak.
5. Mica slate, with silvery mica, . 4 m. N. Ft. Laramie.
6. Granite, pulverulent, . . . Rawhide butte.
7. Felspar, flesh-colored from No. 6, . Rawhide butte.
8. Granite, fine-grained, micaceous, . do.
9. Granite, gray, ... Laramie hills.
10. Quartz, white, ... do.
11. Hornblende slate, . . . do.
12. Hornblende rock, ... do.

MINERALS AND GEOLOGICAL SPECIMENS, *continued.*

13. Mica slate, ... Laramie hills.
14. Hornblende rock in granite, . . . do.
15. Red felspar from No. 14, . . . do.
16. Crystalline quartz from No. 14, . . do.
17. Flesh-colored felspar from No. 14, . . do.
18. Mica slate, with garnets, ... do.
19. Mica slate, with garnets, ... do.
20. Mica, containing iron, ... do.
21. Flesh-colored felspar in large crystals, . do.
22. Chlorite slate, ... do.
23. Mica slate, ... do.
24. Granite, coarse, over No. 23, . . . do.
25. Felspathic granite, pink, . . . do.
26. Quartz veins in No. 25, ... do.
27. Hornblende rock, masses in granite, . do.
28. Granite, fine-grained, ... do.
29. Hornblende rock, ... do.
30. Hornblendic granite, ... do.
31. Hornblende, with crystals of felspar, . do.
32. Mica slate, hornblendic, ... do.
33. Mica slate, hornblendic, ... do.
34. Mica slate, with large plates of mica, . do.
35. Granite, white felspathic, ... do.
36. Quartz, veins in No. 35, ... do.
37. Silicious limestone, Silurian or Devonian, . do.
38. do. highly crystalline, . . do.
39. do. do. . . do.
39½. Syenite, pink, under No. 39, . . . do.
40. Metamorphic silicious limestone, . . Rawhide butte.
41. do. do. purplish, . do.
42. Quartz, in granite, ... do.
43. Metamorphic limestone, gray, . . . do.
44. Mica slate, ... do.
45. Micaceous granite, ... do.
46. do. . . . . do.
47. Mica slate, fine-grained, ... do.
48. Metamorphic limestone, crystalline, . . do.
49. do. purplish, . . do.
50. Metamorphic limestone, similar to No. 48, Rawhide butte.
51. Talcose slate, ... do.
52. Felspathic granite, flesh-colored, . . do.
53. Mica slate, with garnets, ... do.
54. do. very fine-grained, . . . do.
55. Talcose slate, dark, ... do.
56. do. light, ... do.
57. Porphyritic trap, ... Black hills.
58. Hornblende slate, ... do.
59. Felspathic granite, pink, ... do.
60. Plates of mica from No. 59, . . . do.
61. Quartz vein in chlorite slate, . . . do.
62. Chlorite slate, ... do.
63. Trachyte, ... do.
64. Quartz veins in No. 63, ... do.
65. do. . . . . do.
66. Chlorite slate, ... Rawhide butte, W. side.
67. Hornblende rock, underlying Tertiary, . do.
68. Schorl in quartz from clay slate, . . Black hills.
69. do. do. . . do.
70. Augite, ... do.
71. Quartz, with felspar, ... Laramie hills.
72. Porphyritic trap, columnar, . . . Stone butte, Black hills.
73. do. do. . . . do. do.
74. do. do. . . . do. do.
75. Trachyte, ... do. do.
76. Vesicular trap, ... do. do.
77. Trachyte, ... do. do.
78. Silicious limestone, ... Rawhide butte.
79. Porphyritic trachyte, ... Stone butte, Black hills.
80. Compact trachyte, with scales of mica, . Bear peak, do.
81. do. do. do. . do. do.
82. Gray basaltic trap, ... do. do.
83. Porphyritic trachyte, ... do. do.
84. do. . . . . do. do.
85. Quartzite, ... do. do.
86. Gray trachyte, ... do. do.
87. Metamorphic sandstone, ... do. do.

II. SEDIMENTARY ROCKS.

Silurian and Devonian.

89. Potsdam sandstone, red, with *Lingula antiqua* Bear peak.
90. do. gray, fine, with *Obolus*, do.
91. do. porous, with Trilobites, do.
92. Metamorphic, conglomerate over granite, . Laramie hills.
93. do. with cherty pebbles, . . do.
94. do. do. . . do.
95. Argillaceous limestone, Devonian, . . Laramie hills.
96. Metamorphic conglomerate, . . . do.

Carboniferous.

97. Limestone, with spirifer, ... Black hills.
98. Blue cherty limestone, with *Athyris subtilita*, do.
99. do. with corals, . . do.

MINERALS AND GEOLOGICAL SPECIMENS, *continued.*

100. Blue cherty limestone, with *Spirifer lineatus*, Black hills.
101. do. with *Rhynconella Mormoni*, do.
102. do. with *Cyathophyllum*, do.
103. do. with *Zaphrentis*, . do.
104. do. with *Syringapora*, . do.
105. do. *Porites*, . . . do.
106. Yellowish do. over No. 98, with *Spirifer rockymontana*, do.
107. do. do. with *Spirifers cameratus* and *lineatus*, . . . do.
108. Cherty nodules in No. 98, . . . do.
109. *Arragonite*, in No. 98, ... do.
110. Coarse, granular limestone, with crinoidal columns, ... Fort Laramie.
111. Blue, compact, limestone, with *Productus* and *Athyris subtilita*, do.
112. do. with corals, . do.
113. do. with *Spirifer lineatus*, do.
114. Yellowish cherty limestone, with *Productus*, Warm spring near Ft. Laramie.
115. White limestone, with *Spirifer rockymontana*, Near Ft. Laramie.
116. *Athyris subtilita*, from No. 110, . .
117. *Panopæa*, ... Near Tecama, Neb.
118. *Allorisma*, ... Bellevue, Neb.
119. *Productus*, ... do.
120. *Spirifer cameratus*, ... do.
121. *Athyris subtilita*, ... do.
122. *Bellerophon*, ... do.
123. *Chonetes*, ... do.
124. *Chætetes*, ... do.

PERMO-CARBONIFEROUS AND PERMIAN.

125. Arenaceous limestone, foliated with *Bakevellia* Black hills.
126. Red sandstone, soft, very fine grain, under No. 125, ... do.
127. Pink sandstone, over No. 126, . . . do.
128. Limestone, No. 125, with *Orthoceratite*, . do.
129. do. with *Bellerophon*, . do.
130. do. with *Pleurotomaria*, . do.
131. do. with *Spirifer*, . . do.
132. do. with *Allorisma*, . Big Blue, K. T.
133. Yellow magnesian limestone, with *Nautilus*, *Monotis*, *Bakevellia*, *Myalina*, Smoky Hill fork.
134. do. compact, with *Mytilus*, . . Banks of Mo., S. line of Neb.
135. Magnesian limestone, with *Monotis*, . . Big Cottonwood.
136. do. with *Avicula*, . . 12 m. W. Big Blue.
137. Chertz rock, gray, with *Avicula* and *Myalina*, Black hills.
138. Chertz rock (Burch stone), with crinoidal columns, ... Black hills.
139. Saccharoid gypsum, over No. 133, . . Smoky Hill fork.
140. *Monotis* from No. 136, ... do.
141. Blue limestone, porous, with fenestella, . Big Blue.
142. Cellular calcareous rock, ... Smoky Hill fork.
143. do. more compact, . . do.
144. do. with spherical cavities, do.
145. do. more argillaceous, . Near Cottonwood creek.

JURASSIC.

146. Arenaceous limestone, light brown, with *Avicula tenuicostata*, Black hills.
147. do. bluish, over No. 146, with *Avicula*, do.
148. Ferruginous limestone, with *Cypricardia*, do.
149. do. red, with *Avicula*, . do.
150. Yellow arenaceous limestone, with *Serpula*, do.
151. Limestone, bored with lithophagous mollusks, do.
152. Red marl, over No. 141, containing snowy gypsum, ... do.
153. Snowy gypsum from No. 152, . . . do.
154. Crystalline gypsum from seams in No. 152, do.
155. Fibrous gypsum do. do. . . do.
156. Blue compact limestone (freshwater), in No. 158, containing *Unio nucalis* and *Planorbis*, ... do.
157. Arenaceous limestone, same as No. 150, containing pentacrinus, with serpula and ostrea attached to surfaces, . . . do.
158. Yellowish argillo-arenaceous limestone, with ostrea, Upper Jurassic, . . . do.
159. Gray shell limestone, containing *Ammonites*, *Belemnites*, &c., interstratified with No. 158, do.
160. Snowy gypsum, with no stains, equivalent of No. 153, ... Big Horn river.
161. Gypsum, with crystals of selenite, . . do.
162. Snowy gypsum, ... Near sources of Yellowstone.

CRETACEOUS.

Formation No. 1.

163. Conglomerate and sandstone, with *Unios*, . Bad lands of Judith
164. Conglomerate, ... do.
165. do. fine, with *Melanias* and *Cyclas*, do.
166. Gray arenaceous limestone, with *Melania* and *Helix*, ... do.
167. Conglomerate, same as No. 165, . . do.

MINERALS AND GEOLOGICAL SPECIMENS, *continued.*

168. Arenaceous limestone (No. 166), with leaves of *Credneria, Melanias*, &c., . Badlands of Judith
169. Indurated ferruginous clay, with *Melanias*, do.
170. Ferruginous sand, with *Unio danai*, . do.
171. Indurated clay, with *Melanias* and scales of Lepidotus above No. 166, . . do.
172. Shell limestone, containing *Melanias*, . do.
173. Impure sandy lignite (stratum D of section), do.
174. Shell limestone, same as No. 172, . . do.
175. Cream-colored shale, burnt from over lignite beds, ... do.
176. Compact argillaceous limestone, with *Cytherea Oweni* (marine), beneath freshwater beds, ... do.
177. Ferruginous sandstone, with *Tellina subtortuosa*, ... do.
178. Rough, gray, limestone, with *Ostrea glabra*, do.
179. Ferruginous sandstone, with *Inoceramus pertenuis*, upper marine strata, . . do.
180. Lignite, over No. 179, ... do.
181. Carbonaceous sand from decomposition of lignite bed over No. 179, . . . Rocky mountain creek.
182. Impure shaly lignite, with selenite, . . Near Ammel's Is.
183. Limestone, with *Cypris*, lower part of formation No. 1, ... Black hills, E. base.
184. Silicified wood, ferruginous, ... do.
185. do. coniferous, ... do.
186. Bone of saurian, ... do.
187. do. or cetacean, ... do.
188. Dense ferruginous sandstone, . . . Black hills, W. base
189. Quartzose sandstone, bluish, . . . do.
191. Conglomerate from junction of cretaceous and carboniferous rocks, . . . Platte valley.
192. Coarse ferruginous sandstone, with pebbles, over No. 199, ... do.
193. Dark ferruginous sandstone, over No. 192, do.
194. do. containing much iron, do.
195. do. do. do.
196. Ferruginous sandstone, ... Blackbird hill.
197. do. fine-grained, . . Mouth of Elk Horn.
198. Dark, coarse, sandstone, very ferruginous, do.
199. Red, ferruginous sandstone, with many species of dicotyledonous leaves, Black hills.
200. do. do.
201. Light gray quartzose sandstone, with balls of sulphate of iron over No. 199, do.
202. do. with dicotyledonous leaves, do.
203. Whitish pulverulent sandstone, over No. 199, Sioux city.
204. do. fine-grained under No. 199, Blackbird hill.
205. Indurated clay, bluish, ... do.
206. do. yellow, ... Decatur.
207. do. do. . . . . do.
208. Ferruginous sandstone, with striated bivalves, and *Cytherea arenaria*, . . Big Sioux.
209. Indurated clay, with dicotyledonous leaves, do.
210. do. sand, fine, yellow, with leaves of salix, ... do.
211. Ferruginous sandstone, ... Mouth of Iowa creek.
212. do. do. fine-grained, with impressions of dicotyledonous leaves, Mouth Big Sioux.
213. do. with *Solen Dacotaensis*, . do.
214. Lignite under No. 209, ... do.
215. Silicified wood, bored by teredo, . . Big Sioux.
216. do. do. . . Blackbird hills.
217. do. do. . . Smoky hill fork.
218. do. do. . . Republican fork.
219. Coarse, ferruginous sandstone, with leaves of *Credneria*, ... Smoky hill.
220. Sandstone, very ferruginous, . . . do.
221. Cellular, ferruginous, rock, . . . do.

Formation No. 2.

222. Masses of sulphuret iron, with sulphate, . Mouth of Vermi-
223. Crystallized do. do. . do. [lion.
224. do. gypsum, ... do.
225. do. do. . . . . do.
226. do. in plates, ... do.
227. Large crystals selenite, in black clay, . do.
228. do. do. do. . do.
229. Ferruginous shale, with remains of fishes, . do.
230. do. shell limestone, . . do.
231. Yellow clay, with gypsum, . . . do.
232. Conglomerate, with green silicious pebbles, do.
233. do. with shark's teeth, . do.
234. Gray arenaceous limestone, with *Cytherea orbiculata*. do.
235. do. do. with fish-scales. do.
236. Dark gray indurated clay, with fish scales, Black hills, E. base.
237. Arenaceous limestone (No. 234), with *Serpula*, ... Dixon's bluffs.
238. Conglomerate, with fish teeth, . . . do.
239. Arenaceous limestone, gray, with *Inoceramus problematicus*, ... Black hills, W. base

MINERALS AND GEOLOGICAL SPECIMENS, *continued.*

Formation No. 3.

240. Soft yellow limestone, with *Inoceramus problematicus*, ... Big Sioux.
241. Gray marl, with *Ostrea congesta*, and fish remains (base of No. 3), . . . Mouth Jamesriver.
242. do. do. . . . do.
243. Scale of *Cyclocladus* in No. 242, . . do.
244. Fibrous carbonate of lime, with *Ostrea congesta* attached to surface, . . . Dorion's hills.
245. Yellow marl, ... do.
246. do. . . . . Bijoux hills.
247. do. lighter, ... do.
248. Crystalline carbonate of lime, seams in marl, do.
249. do. do. greenish in marl, do.
250. Black plastic clay, upper part of No. 3, . Near Bijoux hills.
251. Shale, argillaceous, with fish remains over No. 250, do.
252. do. calcined by combustion of No. 250, ... do.

Formation No. 4.

253. Blue clay, with *Ptychoceras Mortoni*, . Great bend of Miss.
254. Yellow clay, with crystals of gypsum, . do.
255. Whitish alum clay, seams in No. 253. . Bijoux hills.
256. Hyd. silicate of magnesia, masses in formation No. 4, ... do.
257. Crystals sulphate baryta, ... do.
258. White aluminous earth in seams, . . do.
259. Aluminous clay (No. 255), . . . do.
260. Ferruginous concretions throughout F. No. 4, do.
261. Crystalline argillaceous limestone (Cone in cone), ... Shyenne river.
262. Crystals of selenite in clay beds, . . Fort Pierre.
263. Selenite and fibrous carbonate lime, . . Mouth Shyenne.
264. Yellow clay, with selenite, . . . 12 m. ab. Ft. Pierre.
265. Dark, argillaceous, shale, with *Inoceramus*, } Mouth of Cannon-ball river.
266. Blue concretionary limestone, with *Rostellaria*, ... Long lake, Miss.
267. Indurated clay, ... do.
268. Decomposed shale (No. 253), . . . Fort Pierre.
269. Brown hematite, ... Big Shyenne.
270. do. more earthy, . . do.
271. Dog-tooth spar, ... Mussel-shell river.
272. Gray arenaceous limestone, . . . Milk river.
273. do. with carbonized matter and shells, ... Cannon-ball river.
274. Soft argillaceous shale, ... Yellowstone river.
275. Concretions of compact blue limestone, containing great numbers of fossils, do.
276. do. containing large crustacean (undescribed), ... do.
277. Crystallized carbonate of lime, yellow, forming nucleus of concretions, . . . Forks of Shyenne.
278. Crystals of selenite, ... do.
279. Blue indurated clay, with fibrous gypsum, do.
280. Dove-colored laminated shale, . . . Grand river.
281. Petrified wood, bored by *Teredo bisinuata*,
282. "Cone in cone" (No. 241), . . . Cannon-ball river.
283. Indurated clay, with shells, . . . Grand river.
284. Soft micaceous sandstone, thin seams in clay bed, ... Fort Pierre.
285. Vertebra of *Mososaurus*, ... do.
286. Wood bored by *Xylophaga Stimpsoni*, . Mussel-shell river.
287. White aluminous clay, ... Fort Lookout.

Formation No. 5.

288. Yellow arenaceous limestone, with *Venus*, Head of Little Mo.
289. do. softer, ... do.
290. Yellowish calcareous sandstone, with *Cyprina* Cannon-ball river.
291. do. do. decomposed, do.
292. Soft fine sandstone, with *Rostellaria*, . do.
293. Ferruginous sandstone, with Cytherea, . do.
294. Silicified wood, with bark, . . . Long lake.
295. do. bored by *Teredo globosa*, do.

TERTIARY.

A. Lignite Basin.

296. Yellow arenaceous clay on Cretaceous rocks,
297. Yellowish indurated clay, with freshwater shells over No. 296, ... Long lake.
298. Gray sand, fine, over No. 297, . . . do.
299. Coarse, gray, calcareous sandstone, w'h fossils, Top of Square butte
300. Soft argillo calcareous shale, w'h fossil shells, Thunder butte.
301. Ferruginous shale, with coniferous plants, do.
302. Dove-colored sandstone, with silicified wood, do.
303. Yellow indurated sand, with estuary shell of genus *Cyrena*, ... Cherry creek.
304. Light colored indurated clay, base of section, Fort Clark.
305. Dark carbonaceous clay, over No. 304, . do.
306. Lignite, over No. 305, ... do.
307. Dark argillaceous shale, over No. 306, .

MINERALS AND GEOLOGICAL SPECIMENS, *continued.*

308. Yellow indurated sand, with *Paludina* and *Melania*, ...
309. Grayish indurated sand, ...
310. Dove-colored calcareous shale, with *Unios* and other freshwater shells, . . . Red spring.
311. Argillaceous limestone, with fossil plants, Fort Berthold.
312. Fine light-colored marl, under lignite bed, do.
313. Lignite, bright and compact, . . . do.
314. Drab indurated clay, ... { High butte, Little Missouri.
315. Light-colored marl, with impressions of dicotyledonous leaves, ... Fort Union.
316. Earthy lignite, ... do.
317. Lignite, ... Yellowstone.
318. do. more impure, . . . do.
319. Concretions sulphuret iron, common throughout Tertiary series, ... do.
320. Septaria, spherical, ... Fort Union.
321. Carbonaceous indurated clay, charged with vegetable remains, freshwater and land shells, *Bulimus*, *Physa*, *Pupa*, &c., . do.
322. Mineralized wood, ... do.
323. Carbonized wood from lignite bed, . . do.
324. Light sandy marl, ... do.
325. Shell marl, containing freshwater shells, . do.
326. Impure lignite, ... do.
327. Light-colored fine clay, under lignite bed, do.
328. Brown shale, with vegetable impressions, . Milk river.
329. Silicious shale, containing much vegetable matter, ... do.
330. Gray shell limestone, soft, . . . do.
331. Carbonaceous clay, with *Unio*, *Paludina*, &c., Yellowstone.
332. Coarse gray shell limestone, . . . Elk Horn prairie.
333. Compact bluish limestone, with freshwater shells, ... Red spring.
334. Gray calcareous sandstone, with *Unio*, *Paludina*, &c., ... Yellowstone.
335. Soft argillaceous limestone, with *Paludina trochiformis*, ... Powder river.
336. Crystallized carbonate of lime in concretions, Fort Union.
337. Dove-colored argillaceous limestone, with impressions of ferns, over No. 315, . do.
338. Brown calcareous shale, with *Taxites*, . Yellowstone.
339. Silicified wood, ... do.
340. do. partially carbonized, . . do.
341. do. do. . . . do.
342. do. do. . . . do.
343. Silicified wood, partially carbonized, . Yellowstone.
344. do. cavities lined with drusy quartz, Fort Union.
345. Dove-colored clay, metamorphosed by burning out of lignite beds, . . . Mussel-shell river.
346. Brownish shale, do. do. . do.
347. Scoria, black, formed by do. do. . Yellowstone.
348. do. yellowish do. do. . do.
349. do. black compact do. . do.
350. do. green vitreous do. . do.
351. do. do. do. do. . do.
352. do. red, very porous do. . do.
353. do. brown, very porous do. . do.
354. Shale burned red, with vegetable impressions, do.
355. do. bright red, do. . . do.
356. do. vermilion, with gypsum, . do.
356½. Shale, burned black, ferruginous, . . do.
357. Calcareous pumice from burning of limestone do.

B. White River Basin.

Bed A.

358. Red sandy clay, containing pebbles, base of *Titanotherium* bed, ... On Shyenne river.
359. Teeth of *Titanotherium Prouti*, . . Old Woman's fork.
360. Coarse whitish sandstone, above No. 358, Shyenne river.
361. do. concretionary, . . . do.
362. Soft whitish calcareous sandstone, with scales of mica, ... do.
363. Greenish plastic clay, ... do.
364. do. upper part, . . Sage creek.
365. Plates of chalcedony, ... Bear creek.
366. do. . . . . do.
367. do. . . . . do.
368. Fibrous carbonate of lime, . . . do.
369. Dark chalcedony, ... do.
370. Magnesite, ... do.
371. Calcareous concretion separating bed *a* from bed *b*, ... do.

Bed B.

372. Pinkish indurated marl, ... do.
373. Whitish do. from over No. 372, do.
374. Pinkish calcareous concretion, . . . do.
375. Decomposed marl from Nos. 372 and 373, do.
376. do. do. with *Oreodon*, . do.

Bed D.

377. Cream-colored marl, ... White river.
378. Silicious limestone, with freshwater shells, *Planorbis*, *Limnea*, &c., . . . do

MINERALS AND GEOLOGICAL SPECIMENS, *continued.*

379. Tufaceous, concretionary limestone, . . White river.
380. Cream-colored marl, containing *Oreodon*, . do.

Bed E.

381. Soft white grit, ... do.
382. Conglomerate, above No. 381, . . . do.
383. do. with granitic pebbles, . do.
384. Soft white sandstone, with *Oreodon*, . do.
385. Calcareous conglomerate, . . . Fort Laramie.
386. Conglomerate, ... Bijoux hills.
387. Calcareous concretions in marl, under No. 386, ... do.
388. Sulphate baryta, foliated crystals in No. 387, do.
389. Green silicious concretions in limestone, containing freshwater shells, Medicine hills.
390. do. do. do. do.
391. Coarse, whitish, sandstone, . . . Bad Land creek.
392. Conglomerate, ... Grindstone hill.
393. Quartzose conglomerate, ... do.
394. White infusorial earth, base of bed *e*, local, Running water.
395. do. do. do. Loup fork.
397. Indurated marl, white, ... Warren's fork.
398. Silicious tufa, ... Niobrara river.
399. White marl, ... Loup fork.
400. Whitish cherty limestone, . . . do.
401. White foliated limestone, ... Niobrara river.
403. White tufaceous marl, containing freshwater shells, ... Loup fork.
404. Silicified wood, ... Running water.
405. do. . . . . do.
406. Silicious sinter, ... Sage creek.
407. Carbonate of lime, ... Bear peak.
408. Ferruginous conglomerate, . . . Yellowstone river.
409. Micaceous granite, ... do.
410. Hornblendic rock, ... do.
411. Limestone, with corals, ... do.
412. do. with *Spirifer*, . . . do.
413. do. with *Orthoceratite*, . . do.
414. do. with *Syringopora*, . . do.
415. Chalcedony, ... do.
416. Silicified wood, ... do.
417. Limestone, with red chert, . . . do.
418. Concretions from yellow marl, . . . Big Sioux.
419. Silicious sinter from springs, . . . Black hills.
420. Sand from sand hills, ... do.
421. Very fine gray sand, from sand dune, . Powder river.
422. Prismatic iron ore, ... Mouth Big Horn.
423. Efflorescence on soil, ... Cannon-ball river.
424. Compact basalt, protruded, . . . Bad lands of Judith
425. Trachyte, ... do.
426. Bed pipe-stone, Catlinite, obtained by Maj. H. Day, U. S. A., from near source of Big Sioux, viz. Nicollet, p. 16, . .

Upper Silurian.

427. Yellowish gray silicious limestone, with *Favosites*, collected by Mr. Drexler, . { Near South Pass Rocky Mts.
428. Yellowish limestone, with undetermined corals, ... do.
429. Chalcedony from limestone, . . . do.
430. Cherty limestone, with *Syringopora*, . do.
431. do. with *Halysites escharoides*, do.
432. do. with *Streptalasma*? . do.

Carboniferous and Permian.

433. Impure coal, slaty, ... { Near mouth of Platte river.
434. Compact cherty limestone, . . . Fort Leavenworth.
435. Blue cherty limestone, ... do.
436. Dark, argillaceous, shaly limestone, . . do.
437. Impure coal, laminated, ... { 12 m. beyond Ft. Leavenworth on Ft. Riley road.
438. Yellowish magnesian limestone, with *Myalina*, ... Deep creek, K. T.
439. Dark indurated clay, ... do.
440. Nodular chert, ... Fort Riley.
441. Fine yellow clay, ... Cottonwood creek.
442. Yellowish gray magnesian limestone, with spines of *Archeocidaris*, . . . do.
443. Blue cherty limestone with *Monotis*, . . do.
444. "Cone in cone" overlying coal bed, . . { Near Fort Leavenworth.
445. Fibrous carbonate of lime in thin layers with *Ostrea congesta* attached, Cretaceous formation No. 3, ... } Bryan's fork of Little Blue river, K. T.

PART III.

ZOOLOGY AND BOTANY.

CHAPTER XV.

Mammals.

The mammals of the Upper Missouri collections have been identified and described by Prof. S. F. Baird in his general report, which forms Vol. 8 of the P. R. R. Surveys. The collection comprises skins, skeletons, and skulls of nearly all the larger quadrupeds of the plains, with a large number of specimens of most of the smaller ones. From the following catalogue some idea may be obtained of their geographical distribution in the Northwest, though several species, which are well known in that country, are not included, from the fact that they are not in the collection. The Wolverine (*Gulo luscus*, Sabine) has been killed in the vicinity of Fort Benton, and is not unfrequently seen along the eastern base of the mountains, though none were observed by our party. The little Black Mink (*Putorius nigrescens*) was obtained by Lieut. Couch at Fort Leavenworth, Kansas Territory, and a skin of the black-footed ferret was procured at Fort Laramie by Mr. Alexander Culbertson. This specimen, from which the species was described by Audubon and Bachman, is the only one ever known. Prof. Baird says, "It is a little remarkable that so conspicuous and well-marked a species should have eluded the notice of all the recent explorers in the Platte region."

The Black Bear (*Ursus Americanus*) is said to occur in the region ot Council bluffs. An individual was killed near the mouth of the Vermilion in the autumn of 1856. I cannot ascertain that it has ever been observed above that point along the Missouri. I saw the common Striped Squirrel (*Tamias striatus*) quite abundant at Bellevue, Nebraska, but was unable to obtain a specimen. They do not pass above the mouth of the Niobrara; very few are seen above Council bluffs. One or more species of Flying Squirrel occur in Nebraska, but were not observed by me during my explorations. A species of Mouse (*Perognathus fasciatus* Pr. Max.) was described by the Prince of Neuwied, from Fort Union, near the mouth of the Yellowstone. We were unable to rediscover this interesting species, but it holds a place in the fauna of that region. The Moose (*Alce Americanus*) can scarcely be considered as belonging to the fauna of the Upper Missouri, though several have been killed in that region. One was shot in the valley of the Shyenne river, a second near Milk river. These must have strayed down from the North, as they are not recog-

nized as frequenting any portion of the country drained by the Missouri and its tributaries.

Several species of quadrupeds represented in the collection do not pass above certain limits on the Missouri river.

The *Scalops argentatus* has not yet been observed above the mouth of Big Sioux river, and it is not probable that it will be seen above the rich bottom lands which extend only to the Niobrara; and the mouth of White river may be considered the most northern limit of *Geomys bursarius;* the *Thomomys rufescens*, which has not occurred before, seeming to take its place from thence to the mountains. The Gray and Black Squirrel (*Sciurus Carolinensis*) has not yet passed above the mouth of Big Sioux river, and the *S. Ludovicianus*, or Fox Squirrel, reaches its most northern limit near the mouth of White river. This is doubtless owing to the absence of trees which bear their favorite food. Although a single Otter was taken by our party on the Niobrara river, and is not unfrequently caught near the mouth of Big Sioux, it is very seldom, if ever, seen above Fort Pierre. The Fisher (*Mustela Pennantii*) is somewhat abundant along the rivers and streams flowing from the north into the Missouri, and the Muskrat (*Fiber zibethicus*) is very common around Council bluffs, and gradually ceases before reaching the Niobrara. I have been told by the traders that this animal is occasionally seen along the Missouri near Fort Union and on the Yellowstone, but I have never known of any skins being preserved to authenticate the statements.

Sorex Haydeni, Baird.

Hayden's Shrew. Baird, General Report on Mammals, 1857, p. 29.

This small species of Shrew must be quite rare in Nebraska. During all my examinations of that country, I have been able to secure but three specimens, and these are the only ones at present known. A single specimen was caught near Fort Pierre, a second one at Fort Union, and a third was found dead along the shore of the Missouri river, near the mouth of Cannon-ball river, so that as far as we at present know its range is along the Missouri from latitude 44° 20′ to 48°. Specific character: Head less than eight-tenths of an inch; acutely attenuated. Body about 1 75 hundredths of an inch; vertebræ of tail 1.25. Tail very thick and swollen; hind feet four-tenths of an inch; teeth pitchy chestnut. Color above, grayish chestnut brown; beneath, whitish; upper premolar not imbricated; 3d and 4th equal and decidedly less than the two anterior.

Blarina brevicauda, Gray.

Short-tailed Shrew. Baird, General Report on Mammals, 1857, p. 42.

The only specimen of the above species in our Nebraska collection was discovered near Fort Berthold, on the Missouri river, in latitude 47½°, longitude 102°. Very rare.

Scalops argentatus, Aud. & Bach.

Silvery Mole. Baird, General Report on Mammals, 1857, p. 63.

Very little is yet known of the habits of this beautiful mole, though it has been known to naturalists for several years. It was first discovered on the prairies in Michigan, and described by Audubon and Bachman in their work on Quadrupeds of North America. Though abundant on the rich bottoms along the Lower Missouri, it is seldom, if ever, seen above longitude 98°. A single specimen was caught near the mouth of the Big Sioux in the autumn of 1856. If this animal existed in large numbers, its fine glossy, silky, silvery fur would render it an important object of pursuit for economical purposes. Range: Detroit to mouth of Big Sioux river, and south to Prairie Mer Rouge? It was also obtained by Mr. Wood twenty miles west of Fort Riley, in Kansas Territory.

Lynx rufus, Raf.

Wild Cat. Baird, General Report on Mammals, 1857, p. 90.

Though seldom seen by the traveller, this animal is not rare in any part of the country drained by the Missouri and its tributaries. It is very often caught in the traps which the traders set for wolves. The flesh of the wild cat is not unfrequently used for food by the Indians, and its skin for ornamental purposes. In the month of January, 1855, I attempted to cross the prairie from Pinau's spring to the Fur Company's trading-houses near the forks of the Shyenne river, a distance of about thirty miles. Losing my course, I wandered for two days without food among the innumerable ravines of the tributaries of that river, and on the third day came to a lodge of Sioux Indians, who had separated from their band, and were subsisting on the products of each day's hunt. The old chief offered me kindly the hospitality of his hut, which I gladly accepted, and on entering the lodge found the inmates quietly watching the carcass of a large wild cat, which was roasting before the fire. As soon as the meat was cooked, the Indians ate of it with a keen relish, and placed a portion before me, and though almost famished with hunger, one mouthful was sufficient to satisfy me, and I gladly turned to the more palatable meat of Black-tailed Deer. These animals are caught every year to a greater or less extent at Fort Pierre, Fort Clark, Fort Union, Fort Benton, and on the Yellowstone. Lieut. Warren killed two young wild cats near the "Big Bend" of the Missouri in the autumn of 1856. The skins were preserved and added to our collection. We also obtained the skin of a very large individual near the mouth of Big Sioux river on the Missouri. Range: Atlantic to Pacific. Upper Missouri to Gila river. Not on the Rio Grande? The Canada Lynx (*Lynx Canadensis*) has been seen in many portions of the Upper Missouri country by Indians and traders, but no skins were obtained by our party.

CANIS OCCIDENTALIS, *var.* GRISEO-ALBUS.

WHITE AND GRAY WOLF.

C. OCCIDENTALIS, *var.* NUBILUS.

DUSKY WOLF. Baird, General Report on Mammals, 1857, p. 104.

This animal varies so much in color that the traders on the Upper Missouri suppose that there are four or five species. I have seen them differing in color from an almost snowy whiteness to a dark brown or black, and was at first inclined to attribute this difference to age and sex, but Mr. Zephyr, an intelligent trader, informed me that he had noticed the same variations of color in all ages. It is found more or less numerous throughout the country, though more abundant in those portions where the buffalo range. Countless numbers are seen in the valley of the Yellowstone, and along the Missouri above Fort Union, and woe to any poor buffalo, elk, or deer, which may have been so unfortunate as to have been wounded by the hunter, or to be in the decline of life. Descending the Yellowstone river in an open boat, in the summer of 1854, we passed an old bull lying upon the bank, and evidently alive, surrounded with wolves, who had already deprived him of his nose and tail. He had evidently yielded to his fate, but pitying the poor animal, we hallooed and fired a charge of shot among the wolves, which dispersed them. The old bull revived, started down the bank, and swam across the river to a sandbar, where he fell exhausted. Before we were out of sight, the wolves had surrounded him again, and undoubtedly nothing was left of him in a few hours but a parcel of bones distributed over the prairie. I have never heard of their attacking the settlers and Indians. Their skins are made a considerable article of trade, usually bringing one dollar apiece. Range: Missouri river to the Pacific.

CANIS LATRANS, Say.

COYOTE, PRAIRIE WOLF. Baird, General Report on Mammals, 1857, p. 113.

In the Prairie or Barking Wolf, or as called by the Indians, Medicine Wolf, there is but little variation in color or appearance. It is much more abundant on the Upper Missouri than the large wolf, and collects in larger bands, which seem to act in concert in taking their prey. They are said to station themselves, when in pursuit of the antelope, in such a manner, that when one becomes wearied, a fresh one appears and takes up the chase, until the antelope is captured. They are also said to be very expert in cutting the hamstrings of buffalo, deer, and not unfrequently of horses. They are great enemies of the prairie dog. Multitudes may be seen at all times in their villages, waiting patiently for the dogs to make their appearance. At night, they fill the air with their terrible music. With the Indians, their barking at night always forebodes evil of some kind, and the voyager is reminded of a lurking enemy. At first, one of them will commence a

strain, then another will take it up in some other direction, and so on, until the traveller is convinced that he is surrounded by all the wolves in the country. Their barking sounds much like that of a small dog. Range: From Missouri river to the Pacific, south to the Rio Grande of Texas.

Vulpes macrourus, Baird.

Prairie Fox. Baird, General Report on Mammals, 1857, p. 130.

This beautiful animal is found quite abundantly throughout the Upper Missouri country, where its fur is considered quite valuable. It presents all the different varieties of the common red fox, cross, silver, and black, the fur of which is also very highly prized. I have known the skin of the silver variety to sell for one hundred dollars. In the spring of 1855, I purchased a young prairie fox of the Sioux Indians, near Fort Pierre, and kept him for some months. The troops soon took possession of Fort Pierre, and the fox passed into other hands, and I considered him lost, but on the return of our party to Fort Pierre from the Yellowstone, in the autumn of 1856, I was presented with the identical fox, which I had purchased nearly two years before. He had become quite tame, readily recognized his name, and seemed quite contented in his confinement. We brought him on to Washington, where he was much admired for his beauty, and after a sojourn of a few months in the metropolis, he made his escape, and if now living, doubtless forms a part of the fauna of the Atlantic coast. Range: Upper Missouri to the Plains of Columbia, Oregon Territory.

Vulpes velox, Aud. & Bach.

Kit Fox, Swift Fox, p. 133.

This little Fox is often caught in the traps which the employees of the Fur Company set for wolves. From fifty to one hundred are caught every winter, in the immediate vicinity of each of the trading forts on the Missouri. Its skin is not considered very valuable, bringing only twenty-five cents apiece. Like the prairie wolf, it is found very abundantly about the villages of the prairie dog, and is, I suppose, another of the enemies of that little animal. For what reason it has been called "Swift Fox," I cannot tell, for its speed is less than any other species of fox with which I am acquainted. It is quite abundant all through the Northwest, extending down into Western Iowa. Range: Plains west of the Missouri to the Cascade mountains of Oregon.

Putorius longicauda, Rich.

Long-tailed Weasel. Baird, General Report on Mammals, 1857, p. 169.

Not uncommon throughout the Northwest, though seldom seen by the traveller. Its skin is highly prized by the Indians, who use it for making articles of dress, tobacco

pouches, and for other ornamental purposes. Range: Upper Missouri and Platte rivers. (Carlton House, H. B. T. Rich.)

LUTRA CANADENSIS, Sab.

AMERICAN OTTER. Baird, General Report on Mammals, 1857, p. 184.

Not uncommon along the streams that flow from the north into the Missouri. I cannot ascertain that it has been seen above the mouth of the Niobrara on the Missouri. The only specimen obtained by our party, was taken in a trap set for beaver, on the Niobrara, eighty miles above its mouth. Otter skins are imported into the country every year by the traders, and are prized very highly by the Indians for ornamental purposes. Range: Northern part of the United States to Florida, and west to the Rocky mountains.

MEPHITES MEPHITICA.

COMMON SKUNK. Baird, General Report on Mammals, 1857, p. 195.

Abundant throughout the country drained by the Missouri river and its tributaries. There seems to be some doubt whether the Upper Missouri *Mephites* is specifically identical with the one in the Atlantic States, but the habits of each appear to be alike in all respects. They are equally as troublesome, not unfrequently entering the houses during the night, or destroying the chickens about the forts, and committing other depredations. Range: United States, east of the Missouri plains, and north of Texas.

TAXIDEA AMERICANA, Waterh.

MISSOURI BADGER. Baird, General Report on Mammals, 1857, p. 202.

Generally diffused throughout the Upper Missouri country. Of very little economical value, though used for food by the starving Indian. It is also a great foe to the prairie dog, haunting its villages, and extracting the little inhabitants from their deepest recesses. Range: Iowa and Wisconsin to the Pacific coast, and from Arkansas to 49° north latitude (to 58° north latitude, Rich).

PROCYON LOTOR, Storr.

COMMON RACCOON. Baird, General Report on Mammals, 1857, p. 209.

Has not yet been observed above White river on the Missouri. In the autumn of 1854, while descending the Missouri in a skiff, I killed one of these animals near the edge of the river, about forty miles above the mouth of the Niobrara. It was in a fine condition and furnished me several excellent meals. At Council bluffs and mouth of Big Sioux it is quite numerous, and the Indians carry on a considerable trade in the skins. Range: Massachusetts to Florida, and west to Fort Kearney. Not in Southern Texas?

URSUS HORRIBILIS, Ord.

GRIZZLY BEAR. Baird, General Report on Mammals, 1857, p. 219.

This formidable animal is still quite abundant toward the sources of the Missouri. It lives for the most part upon vegetable food; is fond of the root of *Psoralia esculenta*, of cherries, plums, bulberries, &c., which grow in great abundance throughout the West. It seldom attacks a man unless wounded, when it becomes very fierce, and has not unfrequently destroyed the hunter. At the present time it is very seldom seen below Fort Pierre. I have heard of the common black bear being killed near the mouth of the Vermilion, though I have never seen it, yet am inclined to think it should be included in the Missouri fauna. Range: Plains of the Upper Missouri to the Rocky mountains and along their base, thence to the coast of California. (Not of Oregon and Washington?)

SCIURUS LUDOVICIANUS, Custis.

WESTERN FOX SQUIRREL. Baird, General Report on Mammals, 1857, p. 251.

Very abundant about Council bluffs, gradually becomes rare as we ascend the Missouri, until it ceases to appear near the mouth of White river, in latitude 43¾°, longitude 99½°. Range: Mississippi valley.

SCIURUS CAROLINENSIS, Gm.

GRAY SQUIRREL. BLACK SQUIRREL. Baird, General Report on Mammals, 1857, p. 263.

Two specimens of this Squirrel were taken, one near Fort Leavenworth, K. T., and the other near the mouth of the Platte, N. T. It is seldom if ever seen above this point. Range: Eastern United States to the Missouri river.

SCIURUS FREMONTII, Towns.

MOUNTAIN GRAY SQUIRREL Baird, General Report on Mammals, 1857, p. 272.

A specimen obtained at Laramie peak is supposed to belong to this species; seems to be restricted to the mountains.

SCIURUS HUDSONIUS, Pallas.

RED SQUIRREL. CHICKAREE. Baird, General Report on Mammals, 1857, p. 260.

During the summer and autumn of 1857 I noticed this little Squirrel quite frequently in and around the Black hills. It was most abundant among the oak trees, which were quite numerous, especially on the eastern side of the Black hills. Its habits did not differ from those of the common Red Squirrel of the States, which is familiar to every one. Range: Labrador (latitude 56°) to Mississippi; and in the United States from the Atlantic to the Missouri river.

Tamias quadrivittatus, Rich.

Missouri Striped Squirrel. Baird, General Report on Mammals, 1857, p. 297.

Very common in the "Bad Lands" and rugged portions of the Upper Missouri. It is an active little animal, lives on roots and the seeds of various plants, and is similar in its habits to the common Striped Squirrel of the States. Range: Upper Missouri to Rocky mountains, and west to the Cascade range. Along the Rocky mountains as far south as Fort Staunton, New Mexico.

Spermophilus Franklini, Rich.

Gray Gopher. Baird, General Report on Mammals, 1857, p. 314.

One specimen of the above species was taken near the mouth of Loup fork. Very rare in Nebraska territory. Range: Northern Illinois and Wisconsin, and to Minnesota and Saskatchewan.

Spermophilus tridecem-lineatus, Aud. & Bach.

Striped Gopher. Prairie Squirrel. Baird, General Report on Mammals, 1857, p. 316.

Abundant on all the open prairies of the Northwest; similar in its habits and actions to the prairie dog, though not gregarious; lives on vegetable food entirely, as roots and grass. Range: Eastern Michigan to the plains of the Missouri, and south to Red river, Arkansas, and Fort Thorn, New Mexico.

Spermophilus Townsendii, Bachman.

Townsend's Spermophile. Baird, General Report on Mammals, 1857, p. 326.

A few specimens of the above species were collected near Fort Laramie, and does not differ in its habits from the *S. tridecem-lineatus*. Range: Rocky mountains to the North.

Cynomys Ludovicianus.

Prairie Dog. Baird, General Report on Mammals, 1857, p. 331.

The first village met with in ascending the Missouri is about ten miles below the mouth of the Niobrara, on the left side. The largest one I have ever seen is near the Black hills, north of the Big Shyenne river. This village, though sometimes interrupted by high ridges or hills, is connected, and covers an area of over fifty square miles. The holes are usually about ten or fifteen feet apart, sometimes fifty feet, and are connected by well-trodden paths, which cross and recross each other like the streets of a city. At the head of the Little Missouri river is a village extending about eight miles in every direction. Much has been said about the owl and rattlesnake living in harmony with these animals. Both species are almost invariably seen about the villages. The owls find the deserted holes a convenient place of retreat, and the rattlesnakes doubtless find the dogs to be very palatable food. The snakes have been killed with a full-grown dog in the stomach, and in

some cases they have depopulated whole villages. Range: Milk river and Upper Missouri; west to the Rocky mountains, south to Red river, southwest to the Upper Rio Grande.

Arctomys flaviventer, Bachman.

Yellow-footed Marmot. Baird, General Report on Mammals, 1857, p. 335.

This animal seems to be very rare, but one specimen having been obtained on the Upper Missouri. But two specimens of this species are in the museum of the Smithsonian Institution. Black hills, Nebraska.

Castor Canadensis, Kuhl.

American Beaver. Baird, General Report on Mammals, 1857, p. 355.

The Beaver is one of the most interesting and abundant animals in the West. All the little streams from Council bluffs to the mountains are occupied to a greater or less extent with the indications of their existence. The Yellowstone river, from mouth to source, as well as its tributaries, contain myriads, so that they consume literally acres of the small cottonwood trees which skirt the streams. These animals are usually quiet during the day, but in the far West, they are not unfrequently seen swimming about in the water quite unconcerned. The streams that issue from the Black hills are favorite resorts of them, and I have often known them to strip the streams of all the timber which skirted their borders. On the Yellowstone I saw a cottonwood tree eighteen inches in diameter that had been cut down by them. The tree had lodged; they then took off a length of two feet. Mr. Weld, a trader who has spent many years in the West, informed me that he has known the Beaver to cut down trees thirty inches in diameter. On Manuel's creek, below the mouth of the Niobrara, a small stream about ten yards wide, I saw five dams within the space of a few miles, one of which produced a fall of four feet. They vary somewhat in color, sometimes nearly white. One was caught in the Mussel-shell river in the Blackfoot country that was a perfect cream color, with red eyes, an albino; another from the Big Horn river spotted on the belly like a fawn, and yellowish brown on the back. A tributary of Bear river near Great Salt lake is called Black Beaver creek, because all the Beaver taken from it are of jet black color. Their skins bring at the present time from three to five dollars each. Range: Throughout the entire area of North America.

Geomys bursarius, Rich.

Pouched or Pocket Gopher. Baird, General Report on Mammals, 1857, p. 372.

Very abundant on the rich bottoms of the Missouri, where they are exceedingly troublesome to the farmer. One specimen was obtained near the mouth of Vermilion river, and a second was caught near our camp fire on the Niobrara. This last-mentioned one was

taken alive, but all efforts to domesticate it were fruitless. It died after three days' confinement. Range: Missouri to Minnesota and Nebraska.

Thomomys rufescens, Maxim.

Fort Union Gopher. Baird, General Report on Mammals, 1857, p. 397.

This Gopher seems to take the place of the *Geomys bursarius*, from Fort Pierre to the mountains, but is similar in its habits. Two specimens were taken at Fort Union, and one at Fort Randall.

Jaculus Hudsonius.

Jumping Mouse. Baird, General Report on Mammals, 1857, p. 430.

Only two specimens of this species were taken during the exploration, and they were collected near Fort Union. Range: Nova Scotia to Southern Pennsylvania, and west to the Pacific Ocean.

Perognathus flavus, Baird.

Baird, General Report on Mammals, 1857, p. 423.

Collected on the Loup fork, during the summer of 1857. Range: Upper Missouri, along eastern slopes of Rocky mountains to Sonora and Chihuahua, and along the Rio Grande to Matamoras.

Dipodomys Ordii, Woodh.

Kangaroo Rat. Baird, General Report on Mammals, 1857, p. 410.

A single specimen of the above species was taken on the Niobrara river. Range: Platte river, along the eastern slope of the Rocky mountains, into Durango and Coahuila, Mexico.

Mus musculus, Linn. p. 443.

Already quite abundant and troublesome at all the Fur Trading Posts on the Missouri. *Mus rattus*, or Common Rat, has also been introduced.

Hesperomys Sonoriensis, Leconte.

Baird, General Report on Mammals, 1857, p. 474.

Very abundant near Fort Union and along the Yellowstone Twenty-five specimens were collected. Range: Upper Missouri and Rocky mountains to El Paso and Sonora.

Hesperomys leucogaster.

Missouri Mouse. Baird, General Report on Mammals, 1857, p. 480.

Very rare; but two specimens secured; one near Bijoux hills, the other on Vermilion prairie, and are the only specimens in the Musuem of the Smithsonian Institution. Very little is known of its habits, and it has been observed only on the Upper Missouri.

Neotoma cinerea.

Rocky Mountain Rat. Baird, General Report on Mammals, 1857, p. 499.

Not rare, but seldom taken; usually found among the dry trees on the river bottoms. The only specimen secured was captured at Fort Sarpy, near the mouth of the Big Horn river, on the Yellowstone, in the summer of 1854. Range: Eastern slope of Northern Rocky mountains and Upper Missouri.

Arvicola Haydeni, Baird.

Baird, General Report on Mammals, 1857, p. 543.

But one specimen of this species has ever been detected. Fort Pierre, Nebraska.

Lepus campestris, Bachm.

Prairie Hare. Baird, General Report on Mammals, 1857, p. 585.

I found the Prairie Hare diffused throughout the Upper Missouri country, west and north of Big Sioux river, though never very abundant. It is confined entirely to the prairie, and from that fact derives its name. Its flesh is used for food to some extent, but is not considered a delicacy. It turns white in winter. Range: Upper Missouri, and Saskatchewan plains to the Cascade range of Oregon.

Lepus sylvaticus, Bach.

Gray Rabbit. Baird, General Report on Mammals, 1857, p. 597.

This little rabbit is exceedingly abundant all along the Missouri in the bottoms, where its favorite resort is among the thick willows, upon which it subsists to a great extent. It is most abundant as far up the river as the mouth of the Niobrara, but passing that point, is begins to become rare, and is found only on the willow bottoms skirting the Missouri. Its flesh is very delicate, and affords a most delicious meal to the hungry voyager. Range: From Massachusetts throughout the United States, and west as far as Fort Union, Nebraska.

Lepus artemisia, Bach.

Sage Hare. Baird, General Report on Mammals, 1857, p. 602.

Unlike the *L. sylvaticus*, the Sage Hare is seldom seen in the vicinity of streams, but is mostly confined to the hills and "Bad Lands," where it finds abundant hiding-places to escape from its numerous foes. As we approach the mountains, it becomes very plenty, seeming to take the place of *L. sylvaticus*. It is also abundant on the Sage plains, where the thick sage hedges afford it excellent hiding-places. Range: Region west of the Missouri to the Rocky mountains, and to the Cascade mountains of Oregon, along the Columbia in the north, and to the city of Chihuahua in the south.

ERETHIZON EPIXANTHUS, Brandt.

YELLOW-HAIRED PORCUPINE. Baird, General Report on Mammals, 1857, p. 569.

Occurs rarely throughout the Upper Missouri country. Its quills are much used by the Indian women for ornamental purposes. Range: Upper Missouri, whole of the Pacific coast.

CERVUS CANADENSIS, Eixl.

AMERICAN ELK. Baird, General Report on Mammals, 1857, p. 638.

Much might be said in regard to the habits of this noble animal, but they are now so well known, that I need not dwell on them here. At the present time, the Elk is most abundant on the Upper Missouri, above Fort Union, and in the valley of the Yellowstone. Though rather rare, it is not unfrequently seen below Fort Pierre, throughout Western Iowa. Range: Northern portion of the United States to Upper Missouri, and west to the Pacific. Found in the Alleghanies of Pennsylvania and Virginia.

CERVUS LEUCURUS, Douglass.

WHITE-TAILED DEER. Baird, General Report on Mammals, 1857, p. 649.

The Wood Deer, or White-tailed Deer as it is called by the Indians, is rather common along the timbered streams. Formerly, these animals were very abundant below Fort Pierre to Big Sioux and Council bluffs, but the severity of the cold during the winter of 1855 to 1856 destroyed them so, that at the present time they are very seldom seen. A female was killed near Fort Pierre, with six young in utero. Range: Upper Missouri and Platte to the Columbia river and Washington Territory, Western Texas, and New Mexico?

CERVUS MACROTIS, Say.

MULE OR BLACK-TAILED DEER. Baird, General Report on Mammals, 1857, p. 656.

This is the most abundant animal of the Deer kind in the West. In the interminable ravines that border the rivers, it is found in the greatest abundance. Though very shy, its peculiar haunt is very favorable for the hunter. In the valley of Sage creek and in the Bad Lands these animals are found by hundreds. The valley of the Shyenne is also a favorite haunt for them. They are very seldom found in the prairie, but confined for the most part to the more rugged hills along the streams. They are very prolific, usually producing two, often three, and sometimes four or five young at a birth. The flesh of the Black-tailed Deer, *Sin-ta-sa-pa* in the Sioux language, is very delicate, and more so than that of the *C. leucurus*. I have never seen this Deer below the mouth of the Niobrara. Range: Upper Missouri and Platte to the Cascade range (head of Des Chutes river), Oregon Territory; not extending to the Pacific; head-waters of the Arkansas.

Antilocapra Americana, Ord.

Prong-horned Antelope; Cabrec. Baird, General Report on Mammals, 1857, p. 666.

The Antelope is frequently, but erroneously, called a goat by the mountaineers, who have given it that name to distinguish it from the Mountain Sheep. Very few of these animals are seen below Fort Pierre, none below the mouth of Niobrara river. Near the Bad Lands, Black hills, valley of the Yellowstone, and in the Blackfoot country they are very abundant, but, like the Buffalo, are annually on the decrease. They seem to live mostly in the open prairie, being very seldom seen in the timbered land. In the beginning of winter they may be seen for days following each other in files (if not disturbed) on their way towards the Northwest, leaving the prairie for the more rugged portions of the country near the Black hills or the foot of the mountains. In the spring, usually about March, they may be seen returning again, and distributing themselves over the open prairie. The deep snow and severe cold winter often proves fatal to them, rendering them an easy prey to the myriads of starving wolves. The Antelope usually brings forth two young, less often one and three. Range: Plains west of the Missouri, from the Lower Rio Grande to the Saskatchewan, and west to the Cascade and Coast range of the Pacific slope.

Ovis montana, Cuvier.

Bighorn; Mountain Sheep. Baird, General Report on Mammals, 1857, p. 673.

Confined entirely to the Bad Lands and mountainous portions of the Upper Missouri. They occur in large herds in the Bad Lands or broken country bordering upon the Yellowstone and Missouri rivers above Fort Union. In the vicinity of the mouth of the Judith, the stone walls, &c., are noted places for them. They are the surest footed of all the animals in this country. The meat of the female is much like that of our domestic sheep, but that of the male is usually too highly flavored. They bring forth their young in May or June, most commonly but one at a birth. Range: Broken ground on the Upper Missouri and Platte; Rocky mountains generally, as far west at least as the Coast and Cascade mountains of the Pacific slope.

Bos Americanus, Gmelin.

American Buffalo. Baird, General Report on Mammals, 1857, p. 682.

The Buffalo are confined to the country bordering upon the eastern slope of the Rocky mountains. They occur in large bands in the valley of the Yellowstone river, and also in the Blackfoot country, but their numbers are annually decreasing at a rapid rate. Descending the Yellowstone in the summer of 1854 from the Crow country, we were not out of sight of large bands for a distance of 400 miles. In 1850 they were seen as low down the Missouri river as the mouth of the Vermilion, and in 1854 a few were killed near

Fort Pierre. But at the present time they seldom pass below the 47th parallel on the Missouri. Every year as we ascend the river, we can observe that they are retiring nearer and nearer the mountainous portions. In Kansas they are found at this time at certain seasons of the year in immense droves on the Smoky Hill fork of the Kansas, within 60 or 70 miles of Fort Riley, and from there to the South Pass they are distributed to a greater or less extent. It is true that these animals are at all times on the move, and frequent different portions of the West at different seasons of the year, or as they are driven by the hunters and Indians; but there are certain parts of the country over which they formerly roamed in immense herds, but are never or rarely seen at the present time. The area over which the Buffalo graze is annually contracting its geographical limits. As near as I could ascertain, about 250,000 individuals are destroyed every year, about 100,000 being killed for robes. At the present time, the number of males to the females seems to be in the ratio of ten to one, and this fact is readily accounted for from the fact that the males are seldom killed when the cows can be obtained. Skins of females only are used for robes, and are preferred for food. Beside the robes which are traded to the whites by the Indians, each man, woman, and child requires from one to three robes a year for clothing. A large quantity are employed in the manufacture of lodges, and an immense number of the animals, which it would be difficult to estimate, are annually destroyed by wolves and by accidents. The Buffaloes vary in color, white, cream, gray, sometimes spotted with white, with white feet and legs, &c. These varieties are called by the Indians "Medicine Buffaloes," and are regarded of the greatest value, often bringing several hundred dollars. About one in 50,000 is an albino, while one robe in 100,000 is called by the traders a silk robe, and is usually valued at from one to two hundred dollars. Range: Formerly found throughout nearly the whole of North America, east of the Rocky mountains; now confined to the plains west of the Missouri and along the slopes of the Rocky mountains.

VESPERTILIO PRUINOSUS, Say. All over the United States east of the Rocky mountains.

VESPERTILIO NOCTIVAGANS, Leconte. Common throughout the country east of the Rocky mountains.

VESPERTILIO NOVEBORACENSIS, Gmelin.

CHAPTER XVI.

BIRDS.

CATHARTES AURA, Illig.

TURKEY BUZZARD. Baird, General Report on Birds, p. 4.

Very abundant throughout the Northwest generally.

FALCO ANATUM, Bonaparte.

DUCK HAWK. Baird, General Report on Birds, p. 7.

This very rare bird in the West was killed on the Vermilion river in the autumn of 1856. No other specimen was obtained by our Expedition, and the above locality is the most western range yet known of this bird.

HYPOTRIORCHIS COLUMBARIUS, Gr.

PIGEON HAWK. Baird, General Report on Birds, p. 9.

One of the most common and abundant birds in the Northwest. It is usually found along the woody bottoms of streams, where it may be seen in large numbers perched upon the dry limbs of trees apparently watching for its prey.

FALCO POLYAGRUS, Cassin.

PRAIRIE FALCON. Baird, General Report on Birds, p. 12.

Is found at various localities along the Missouri, though not abundant. It also occurs on the Platte.

TINNUNCULUS SPARVERIUS, Vieill.

SPARROW HAWK. Baird, General Report on Birds, p. 13.

One of the most abundant birds on the Upper Missouri. It is very common along the woody bottoms of the Missouri and Yellowstone, where it may be seen at all hours of the day darting from tree to tree or sitting upon some dry limbs almost motionless watching for its prey. It is an exceedingly noisy and saucy bird, often provoking a shot from the hunter when silence would have enabled it to have escaped unnoticed.

ACCIPITER MEXICANUS, Swains.

BLUE-BACKED HAWK. Baird, General Report on Birds, p. 17.

Not abundant on the Missouri generally, though found quite numerous on the Yellowstone river. It seems to be confined to Western North America. Three specimens were obtained by our party.

BUTEO SWAINSONI, Bonap.

SWAINSON'S HAWK. Baird, General Report on Birds, p. 19.

We were enabled to secure four specimens of this rare and interesting hawk. It seems to be confined to the sources of the Missouri and Yellowstone.

BUTEO BAIRDII, Hoy.

BAIRD'S HAWK. Baird, General Report on Birds, p. 21.

This, also, like the last, is quite rare and interesting to ornithologists, of which three specimens are included in our collection. Its range is Northern and Western North America.

BUTEO BOREALIS, Vieill.

RED-TAILED HAWK. Baird, General Report on Birds, p. 25.

This hawk is not uncommon throughout the prairie country of the Northwest. It may be seen about sunset hovering quietly over the tall grass of the prairie; sometimes sailing along as if without an effort; again, poised almost motionless, with head directed toward the ground as if intently searching for its prey. When thus engaged in searching for its food, it will fly very near the hunter, and often presents itself a fine mark for the gun. Its range seems to be, according to Prof. Baird, Eastern North America, Fur countries, &c. Three specimens are included in our collection.

ARCHIBUTEO FERRUGINEUS, Gray.

SQUIRREL HAWK. Baird, General Report on Birds, p. 34.

This is one of the largest and most beautiful of the hawk kind. It is very rare in the Northwest. The only specimen obtained in all our explorations was killed by Lieut. Warren, in the summer of 1856, on the Little Missouri or Teton river, Nebraska. It is confined to Western North America.

CIRCUS HUDSONIUS, Vieillot.

MARSH HAWK. Baird, General Report on Birds, p. 38.

A very common hawk throughout the Northwest. Its range is given as all of North America and Cuba. Four specimens in our collection.

HALIAETUS LEUCOCEPHALUS, Savigny.

BALD EAGLE. Baird, General Report on Birds, p. 43.

This bird was not unfrequently observed during our explorations, and it seems to be generally distributed throughout the Northwest. A number of specimens were secured, mostly in a young condition. It occurs throughout North America.

BUBO VIRGINIANUS, Bonap.

GREAT HORNED OWL. Baird, General Report on Birds, p. 49.

Is very common throughout the prairie country of the Northwest. In the winter it becomes white, and is often seen by the voyageur of the prairie perched upon some conical hill. When the prairie has been burned over by the autumn fires, this bird presents quite a conspicuous appearance at a distance from contrast, and may sometimes be mistaken for a bleached buffalo skull. It is distributed throughout the whole of North America.

OTUS WILSONIANUS, Lesson.

LONG-EARED OWL. Baird, General Report on Birds, p. 53.

Not uncommon throughout the Northwest. It was not an unfrequent visitor near our

camp-fires at night, where it would have been welcome but for its ominous notes, which were anything but agreeable. It is distributed throughout all temperate North America.

Brachyotus Cassinii, Brewer.

Short-eared Owl. Baird, General Report on Birds, p. 54.

This owl must certainly be very rare on the Upper Missouri. We were able to secure but two specimens during our explorations, and these were taken on White river and near the Bad Lands. I think I have seen the same species at other localities, but quite rarely. Generally diffused.

Syrnium nebulosum, Gray.

Barred Owl. Baird, General Report on Birds, p. 56.

Quite rare, but one specimen secured. Prof. Baird says of this bird: "Though of frequent occurrence in the States of the Atlantic, this species has not yet been observed in the countries west of the Rocky mountains. The only specimen in the present collection is from the Territory of Nebraska, and is of especial interest, as demonstrating the most western locality yet determined of this bird.

Athene hypugaea, Bonap.

Prairie Owl. Baird, General Report on Birds, p. 59.

I do not now remember that I have ever seen a prairie dog village in the Northwest that was not inhabited by one or more pairs of this interesting and somewhat peculiar bird. It does not appear to live with the dogs, but to take possession of the deserted holes, where it retires on the least approach of danger. It is not confined, however, to the villages of the prairie dog, but is often seen near the deserted holes of wolves, foxes, and other burrowing animals of the prairie. It probably consumes no nobler prey than insects or small mice. Its range is from the Mississippi to the Rocky mountains.

Conurus Carolinensis, Kuhl.

Parakeet. Baird, General Report on Birds, p. 67.

Very abundant in the Mississippi valley, along the thickly wooded bottoms as far up the Missouri as Fort Leavenworth, possibly as high as the mouth of the Platte, but never seen above that point. Mostly confined to the South and Southwestern States.

Coccygus Americanus, Bonap.

Yellow-billed Cuckoo. Baird, General Report on Birds, p. 76.

Quite common along the wooded bottoms of streams in the Northwest. Its range is Eastern United States to the Missouri plains.

Coccygus erythrophthalmus, Bp.

Black-billed Cuckoo. Baird, General Report on Birds, p. 77.

Six specimens of this and the preceding bird are included in our Nebraska collection. The habits of both species are much alike, and their geographical distribution much the same.

Picus villosus, Linn.

Hairy Woodpecker. Baird, General Report on Birds, p. 84.

Not uncommon on the dry trees of the river bottoms of the Northwest. Six specimens were secured. It ranges throughout the Northern and Western regions.

Picus pubescens, Linn.

Downy Woodpecker. Baird, General Report on Birds, p. 89.

Seems to have habits and geographical distribution similar to the preceding, though, perhaps, less abundant.

Picoides dorsalis, Baird.

Striped Three-toed Woodpecker. Baird, General Report on Birds, p. 100.

The only specimen we observed of this species was taken near Laramie peak, and is one of the novelties secured in our explorations. In regard to its habits, I know nothing. The locality from which this species was obtained would well reward a more extended examination, for I have never known a region which seemed to promise so many novelties to the ornithologist. We were able to spend but two days in this vicinity, yet in that period we secured, in addition to fine collections in other departments, thirty-five specimens of birds, most of them rare; one species, entirely new to science, and a second, of which but one specimen had been obtained previously.

Sphyropicus varius, Baird.

Yellow-bellied Woodpecker. Baird, General Report on Birds, p. 103.

Very abundant along the wooded bottoms of the Missouri. It ranges from the Atlantic Ocean to the eastern slopes of the Rocky mountains, and occurs in Greenland.

Sphyropicus thyroideus, Baird.

Brown-headed Woodpecker. Baird, General Report on Birds, p. 106.

This rare bird forms another of the results of our visit to Laramie peak. But three specimens are contained in the collections of the Smithsonian Institution. It seems to be confined to the region of the Rocky mountains.

Hylotomus pileatus, Baird.

Black Woodpecker. Baird, General Report on Birds, p. 107.

Though no specimens of the above species is contained in our Nebraska collections, we

often met with it along the wooded bottoms of the Missouri, especially in the State of Missouri, and in Kansas and Iowa. It is very rarely seen as high up the Missouri river as Fort Randall, near latitude 43°, longitude 99°, but it is never seen on the Upper Missouri.

Centurus Carolinus, Bonap.

Red-bellied Woodpecker. Baird, General Report on Birds, p. 109.

Quite rare in the Northwest. Ranges from the Atlantic coast to the eastern slope of the Rocky mountains.

Melanerpes erythrocephalus, Sw.

Red-headed Woodpecker. Baird, General Report on Birds, p. 113.

This is one of the most abundant birds in the Northwest. Scarcely a dry tree is seen along the wooded bottoms of the Missouri or its tributaries, that is not the abode of one or more pairs of this beautiful species.

Melanerpes torquatus, Bonap.

Lewis's Woodpecker. Baird, General Report on Birds, p. 115.

This bird seems to be confined to the immediate vicinity of the mountains. I first observed it associated with the preceding in March, 1855, near the Black hills, and at Laramie peak we met with it in great numbers. It seems to be common to both sides of the Rocky mountain range.

Colaptes auratus, Swainson.

Yellow-shafted Flicker. Baird, General Report on Birds, p. 118.

Abundant along the wooded bottoms of the Missouri and its tributaries.

Colaptes Mexicanus, Swains.

Red-shafted Flicker. Baird, General Report on Birds, p. 120.

Unlike the last, this species is seldom seen along the valleys of streams, but is most abundant in the wooded ravines of the Bad Lands, high up towards the sources of the Missouri. Range: From the Black hills to the Pacific.

Colaptes hybridus, Baird.

Hybrid Woodpecker. Baird, General Report on Birds, p. 122.

Under the above name, Professor Baird includes a remarkable species of woodpecker, from the Upper Missouri and Yellowstone, which seems to be a hybrid between the two preceding. Twenty-one specimens were obtained in our explorations.

Chaetura pelasgia, Steph.

Chimney Swallow. Baird, General Report on Birds, p. 144.

Quite rare on the Upper Missouri. But one specimen was secured, and that was taken

near Bijoux hills. Other parties have obtained it from Independence, on the Missouri river. Its range is Eastern United States to the slopes of the Rocky mountains.

ANTROSTOMUS VOCIFERUS, Bonap.

WHIP-POOR-WILL. Baird, General Report on Birds, p. 148.

Though no specimens of the above species were obtained by us, we have heard its well-known notes every spring in ascending the Missouri, near the mouth of Big Sioux river. I do not think that it is found on the Upper Missouri.

ANTROSTOMUS NUTTALLI, Cassin.

POOR-WILL. Baird, General Report on Birds, p. 149.

Though rarely seen, this bird seems to be distributed throughout the Upper Missouri country. It is usually found on the Sage plains, and rises up quickly from the ground before the traveller, flies a short distance with great rapidity, and then settles down again in some concealed place. I think I have never seen more than six or eight individuals in a single season, but its familiar notes "poor-will" are often heard about dusk, and continue until late at night. It is found on the high central plains to the Pacific.

CHORDEILES POPETUE, Baird.

NIGHT HAWK. Baird, General Report on Birds, p. 151.

Very abundant throughout the Northwest.

CERYLE ALCYON, Boie.

BELTED KINGFISHER. Baird, General Report on Birds, p. 159.

This bird, though not common, is seen occasionally along all the streams of the Northwest. It usually makes its appearance about the first of May. It is universally distributed over North America.

TYRANNUS CAROLINENSIS, Baird.

KING BIRD; BEE BIRD. Baird, General Report on Birds, p. 171.

Very abundant, especially along the Lower Missouri, but found more or less numerous throughout the Northwest. It ranges over Eastern North America to the Rocky mountains.

TYRANNUS VERTICALIS, Say.

ARKANSAS FLYCATCHER. Baird, General Report on Birds, p. 173.

The two species of the genus *Tyrannus* which occur in the Northwest, seem to have habits very much alike, and are often found together, so much so that I at first, with my slight knowledge of ornithology, regarded them as male and female of the same species. The yellow-breasted Tyrannus does not make its appearance, however, until we reach a

point about 100 miles below Fort Pierre, and from there to the mountains. The *T. Carolinensis* diminishes in numbers, while the *T. verticalis* becomes exceedingly abundant, occurring in vast numbers along the wooded bottoms of streams. It is peculiarly a Western bird, ranging from the high central plains to the Pacific.

Sayornis fuscus, Baird.

Pewee. Baird, General Report on Birds, p. 184.

Quite rare along the Missouri river, though not unfrequently seen on the lower portion; gradually diminishes in numbers as we approach the mountains. It occurs to a greater or less extent throughout Eastern North America.

Sayornis Sayus, Baird.

Say's Flycatcher. Baird, General Report on Birds, p. 185.

Seems to be peculiar to the West or Rocky mountain region. It is quite rare, almost always occurring solitary among the ravines of the Bad Lands. I do not think I have ever seen more than fifteen or twenty individuals.

Contopus Richardsonii, Baird.

Short-legged Pewee. Baird, General Report on Birds, p. 189.

Distributed throughout the Northwest, though rarely seen. But two specimens are included in our collection.

Empidonax minimus, Baird.

Least Flycatcher. Baird, General Report on Birds, p. 195.

Occasionally seen throughout the Northwest, though not abundant. Six specimens were obtained in our explorations.

Turdus mustelinus, Gm.

Wood Thrush. Baird, General Report on Birds, p. 212.

Quite abundant along the wooded bottoms of the Missouri to the mountains.

Turdus fuscescens, Stephens.

Wilson's Thrush. Baird, General Report on Birds, p. 214.

Observed along the wooded bottoms of the Lower Missouri. Not very abundant. Its range: Eastern North America and the Fur countries north.

Turdus Swainsonii, Cab.

Olive-backed Thrush. Baird, General Report on Birds, p. 216.

More abundant and more widely distributed than the preceding species, being occasionally observed throughout the Northwest. It is also found at Fort Laramie and Fort Bridger.

TURDUS ALICIAE, Baird.

GRAY-CHEEKED THRUSH. Baird, General Report on Birds, p. 217.

Was not observed above the mouth of Niobrara river on the Missouri. Most abundant along the wooded bottoms of the Mississippi and the Lower Missouri.

TURDUS MIGRATORIUS, Linn.

ROBIN. Baird, General Report on Birds, p. 218.

I have seen this common and widely distributed bird at different seasons of the year throughout the Northwest. In the autumn it appears on the Yellowstone and the sources of the Missouri in vast numbers, especially when the autumn fruits ripen. It arrives at Fort Pierre about the middle of April; and though I have seen it at all seasons of the year I have never heard its song.

SIALIA SIALIS, Baird.

BLUE BIRD. Baird, General Report on Birds, p. 222.

Not uncommon throughout the Northwest; also in the vicinity of Fort Laramie.

SIALIA ARCTICA, Swains.

ROCKY MOUNTAIN BLUE BIRD. Baird, General Report on Birds, p. 224.

Very abundant in the vicinity of the mountains. At Laramie peak and from thence to the Black hills it was one of the most abundant birds noticed. Its range is Upper Missouri to the Rocky mountains, and south to Mexico; rare on the coast of California.

REGULUS CALENDULA, Licht.

RUBY-CROWNED WREN. Baird, General Report on Birds, p. 226.

Found somewhat rarely along the broad bottoms of the Lower Missouri. Range: From the Atlantic to the Pacific.

ANTHUS LUDOVICIANUS, Licht.

TIT-LARK. Baird, General Report on Birds, p. 232.

This species must be very rare on the Upper Missouri, inasmuch as but a single specimen was secured, and that was observed near the Black hills. It is found throughout North America generally.

MNIOTILTA VARIA, Vieill.

BLACK-AND-WHITE CREEPER. Baird, General Report on Birds, p. 235.

Very abundant along the willow bottoms of the Missouri, as high up as Fort Pierre at least. Six specimens were obtained by our party.

PARULA AMERICANA, Bonap.

BLUE YELLOW-BACK. Baird, General Report on Birds, p. 238.

This small bird is very abundant in the months of May and June along the wooded

bottoms of the Missouri. Its minute size and rapid flight from limb to limb among the tallest branches of the lofty cottonwoods renders it a somewhat difficult bird to secure. It is most abundant on the Lower Missouri below Fort Pierre.

Geothlypis trichas, Cab.

Maryland Yellow-throat. Baird, General Report on Birds, p. 241.

A very abundant little bird, inhabiting the thick willow bottoms of the different streams along the Missouri, from the mouth to the source, in the mountains. Seven specimens were collected.

Icteria longicauda, Lawr.

Long-tailed Chat. Baird, General Report on Birds, p. 249.

Very abundant among the low bushes of the bottom prairies along the Missouri. It conceals itself among the foliage, so that it is seldom seen, and seems to rival the mocking bird in the rapidity and variety of its notes. Its range is confined to the west of the Mississippi.

Helminthophaga celata, Baird.

Orange-crowned Warbler. Baird, General Report on Birds, p. 257.

Two specimens of the above species were collected by our party; one near the mouth of the Big Sioux river, and the other on Bon Homme island. Whether it occurs high up on the Missouri we do not know, but it has been found in Oregon and other contiguous territories. We infer that it will be observed in other portions of Nebraska.

Seiurus aurocapillus, Sw.

Golden-crowned Thrush. Baird, General Report on Birds, p. 260.

A common, quiet bird, hopping about on the ground under the thick bushes or trees of the Missouri bottoms, below Fort Pierre. It was not observed above that point.

Seiurus noveboracensis, Nutt.

Water Thrush. Baird, General Report on Birds, p. 261.

Less abundant than the last, and noticed very near the mouth of Vermilion river, where two specimens were secured.

Dendroica coronata, Gray.

Yellow-rump Warbler. Baird, General Report on Birds, p. 272.

Very abundant along the wooded bottoms of the Missouri and its tributaries. Somewhat rare above Fort Pierre.

Dendroica Audubonii, Baird.

Audubon's Warbler. Baird, General Report on Birds, p. 273.

The only specimen of this species observed was collected in the Laramie mountains near Fort Laramie. It is probably quite rare on the Missouri.

Dendroica Pennsylvanica, Baird.

Chestnut-sided Warbler. Baird, General Report on Birds, p. 279.

Observed only at the mouth of the Platte, and is, I think, quite rare. But one specimen was taken.

Dendroica striata, Baird.

Black Poll Warbler. Baird, General Report on Birds, p. 280.

Abundant along the wooded bottoms and on the islands of the Lower Missouri, below Fort Pierre.

Dendroica æstiva, Baird.

Yellow Warbler. Baird, General Report on Birds, p. 282.

Distributed throughout the valleys of the Missouri and its tributaries. Very abundant. Fifteen specimens were collected.

Dendroica maculosa, Baird.

Black and Yellow Warbler. Baird, General Report on Birds, p. 284.

The whole series of Warblers seem to be peculiar to the wooded margins of streams, and are usually quite abundant during the months of May and June.

Setophaga ruticilla, Sw.

Redstart. Baird, General Report on Birds, p. 297.

This beautiful little species is not uncommon along the wooded bottoms of the Missouri and its tributaries, though most abundant on the Lower Missouri. Its range is over the Eastern United States to the Rocky mountains, south and west to Fort Bridger.

Pyranga Ludoviciana, Bonap.

Louisiana Tanager. Baird, General Report on Birds, p. 303.

But two specimens of this species were obtained, and these were from the Black hills and Laramie peak. Dr. Cooper collected it near Fort Laramie. It ranges from the Black hills to the Pacific, and south to Mexico.

Hirundo horreorum, Barton.

Barn Swallow. Baird, General Report on Birds, p. 308.

Builds its nests on the vertical sides of the bluffs along the Missouri, in countless numbers.

Hirundo lunifrons, Say.

Cliff Swallow. Baird, General Report on Birds, p. 309.

This species is very abundant along the Missouri, often covering the vertical sides of the river bluffs with their nests. Near the mouth of the Niobrara river, the chalk bluffs, and

Cretaceous formation No. 3, form lofty vertical walls, which are sometimes completely covered with their nests. A single shot is usually sufficient to supply one with all the specimens he could desire.

Cotyle riparia, Boie.

Bank Swallow. Baird, General Report on Birds, p. 313.

The vertical banks of yellow marl which are so conspicuous from the mouth of the Platte to the Niobrara, furnish excellent places of resort for this bird. Not unfrequently, this and the preceding species will be associated in the same cliff, the *C. riparia* in the surface deposit of yellow marl, while the *H. lunifrons* attaches its nest to the harder rocks below. Both this and the preceding species are universally diffused throughout North America.

Progne purpurea, Boie.

Purple Martin. Baird, General Report on Birds, p. 314.

Most abundant throughout the Northwest, along the wooded bottoms of streams, where the dry trees are its favorite breeding-places. They do not usually remain longer than the months of May and June.

Ampelis cedrorum, Baird.

Cedar Bird. Baird, General Report on Birds, p. 318.

Abundant everywhere in the Northwest. A second species, *A. garrulus*, will doubtless be found in great numbers in the mountains, as it occurs so abundantly near Fort Bridger.

Myiadestes Townsendii, Cab.

Townsend's Flycatcher. Baird, General Report on Birds, p. 321.

Seems to be confined, as far as our observations extended, to the vicinity of the mountain ranges. Specimens were obtained at Laramie peak and the Black hills.

Collyrio borealis, Baird.

Great Northern Shrike. Baird, General Report on Birds, p. 324.

Not uncommon from Council bluffs to Fort Pierre, especially during the winter. Lieut. Warren collected one specimen near Fort Pierre, and had it been abundant above that point, our party would have obtained other specimens.

Collyrio excubitoroides, Baird.

White-rumped Shrike. Baird, General Report on Birds, p. 327.

This species, unlike the preceding, seems to be quite abundant, especially along the Platte to the Laramie mountains, Black hills, and Bad Lands. It is very abundant in the hills about Fort Laramie.

Vireo gilvus, Bonap.

Warbling Flycatcher. Baird, General Report on Birds, p. 335.

Abundant along the wooded bottoms of the Missouri.

Vireo solitarius, Vieill.

Blue-headed Flycatcher. Baird, General Report on Birds, p. 340.

With the preceding species.

Mimus Carolinensis, Gray.

Cat Bird. Baird, General Report on Birds, p. 346.

Abundant throughout the Northwest, from the mouth of the Missouri to the mountains.

Oreoscoptes montanus, Baird.

Mountain Mocking-Bird. Baird, General Report on Birds, p. 347.

A single specimen of the above species was obtained in the Black hills. Dr. Cooper collected it near Fort Laramie.

Harporhynchus rufus, Cab.

Brown Thrush. Baird, General Report on Birds, p. 353.

Distributed throughout the Northwest to a greater or less extent. Six specimens are included in the Nebraska collection.

Salpinctes obsoletus, Cab.

Rock Wren. Baird, General Report on Birds, p. 357.

This somewhat peculiar bird is very abundant in the rugged, inaccessible portions, called the "Bad Lands," of the Northwest. It seems to build its nest among the rocks, where it sets up an impertinent chattering at the approach of a human being, but retires to hiding-places at the first indication of danger. Its range seems to cover the eastern slope of the Rocky mountains to the Cascade range, also in California. Six specimens were secured at various localities along the Missouri.

Cistothorus palustris, Cab.

Long-billed Marsh Wren. Baird, General Report on Birds, p. 364.

Quite rare, though seen occasionally around the marshy places on the broad bottoms of the Missouri near Council bluffs and Big Sioux.

Cistothorus stellaris, Cab.

Short-billed Marsh Wren. Baird, General Report on Birds, p. 365.

Same as preceding.

Troglodytes aedon, Vieill.

House Wren. Baird, General Report on Birds, p. 367.

Not rare as high up the Missouri as the settlements extend; seldom, if ever, seen on the Upper Missouri. A single specimen was secured in the summer of 1857, near the mouth of Loup fork.

Troglodytes Parkmanni, Aud.

Parkman's Wren. Baird, General Report on Birds, p. 367.

This small species we found to be very abundant throughout the Northwest. Thirteen specimens were obtained in our explorations. It seems to be peculiarly a Western species, ranging from the Rocky mountains to the Pacific.

Sitta Canadensis, Linn.

Red-bellied Nuthatch. Baird, General Report on Birds, p. 376.

Quite rare in the Northwest. Seems to frequent for the most part, the wooded ravines of the Bad Lands, and along streams. We were able to secure but three specimens, from two localities, Cedar island on Missouri river, and Black hills.

Polioptila caerulea, Sclat.

Blue-gray Gnatcatcher. Baird, General Report on Birds, p. 380.

We were able to obtain but one specimen of this species, and therefore suppose it to be quite rare. This was found near Bald island, Nebraska. It also occurs in Kansas near Fort Riley.

Lophophanes bicolor, Bonap.

Tufted Titmouse. Baird, General Report on Birds, p. 384.

Must be very rare in the Northwest, inasmuch as but one specimen was secured by our party. It was not observed above St. Joseph on the Missouri.

Parus septentrionalis, Harris.

Long-tailed Chickadee. Baird, General Report on Birds, p. 389.

Very abundant in the willow bottoms along streams throughout the Northwest. Four specimens were secured.

Eremophila cornuta, Boie.

Sky Lark. Baird, General Report on Birds, p. 403.

Large numbers of this beautiful species are found throughout the prairie country of the Northwest. It seems to be gregarious, and to have a special fondness for the villages of the prairie dog, where they may be seen in large flocks. Twelve specimens are included in our collection.

Carpodacus purpureus, Gray.

Purple Finch. Baird, General Report on Birds, p. 412.

Seems to be quite rare, as but one specimen was obtained by our party. The only locality where we observed it was near the mouth of the Vermilion river on the Missouri, and I suspect that it does not occur on the Upper Missouri.

CHRYSOMITRIS TRISTIS, Bonap.

YELLOW BIRD. Baird, General Report on Birds, p. 421.

Very abundant throughout the Northwest. Common from the Atlantic to the Pacific.

CHRYSOMITRIS PINUS, Bonap.

PINE FINCH. Baird, General Report on Birds, p. 425.

This species was observed in but one locality on the Missouri, and that was between Fort Union and Fort Benton.

CURVIROSTRA AMERICANA, Wils.

RED CROSSBILL. Baird, General Report on Birds, p. 426.

Quite abundant in the mountain ranges, where it feeds upon the seeds of the different kinds of Pine cones.

CURVIROSTRA LEUCOPTERA, Wils.

WHITE-WINGED CROSSBILL. Baird, General Report on Birds, p. 427.

Associated with the preceding species, with habits quite similar. Abundant in the Laramie range of mountains.

PLECTROPHANES ORNATUS, Towns.

CHESTNUT-COLLARED BUNTING. Baird, General Report on Birds, p. 435.

This species seems to be peculiar to the prairie country of the Upper Missouri, and is quite abundant. Five specimens were collected.

PLECTROPHANES MELANOMUS, Baird.

BLACK-SHOULDERED LONGSPUR. Baird, General Report on Birds, p. 436.

This bird has a much wider range, extending along the eastern slope of the Rocky mountains to Mexico. It is not abundant along the Missouri. Two specimens were collected in the Black hills, and one on the Niobrara river.

PLECTROPHANES MACCOWNII, Lawr.

MACCOWN'S LONGSPUR. Baird, General Report on Birds, p. 437.

Ranges like the preceding species over a large area of the West. We did not observe it along the Missouri. But three specimens were collected near the Black hills.

PASSERCULUS SAVANNA, Bonap.

SAVANNAH SPARROW. Baird, General Report on Birds, p. 442.

Very abundant on the Western prairies.

POOECETES GRAMINEUS, Baird.

GRASS FINCH. Baird, General Report on Birds, p. 447.

Abundant on the broad upland prairies of the far West. It is diffused over Kansas and Nebraska.

Coturniculus passerinus, Bonap.

Yellow-winged Sparrow. Baird, General Report on Birds, p. 450.

Abundant along the valley of the Platte river. We secured twelve specimens along the Loup fork, a branch of the Platte.

Coturniculus Henslowi, Bonap.

Henslow's Bunting. Baird, General Report on Birds, p. 451.

One specimen of the above species was obtained in the Platte valley, in 1857. Doubtless rare.

Chondestes grammaca, Bonap.

Lark Finch. Baird, General Report on Birds, p. 456.

Occurs in great numbers throughout the prairie country of the Northwest. Nineteen specimens are included in our collection.

Zonotrichia leucophrys, Sw.

White-crowned Sparrow. Baird, General Report on Birds, p. 458.

Belongs to a species of sparrows which are very abundant throughout the prairie country of the Northwest. Ranges throughout northern North America.

Zonotrichia Gambelii, Gambel.

Gambel's Finch. Baird, General Report on Birds, p. 460.

Not quite as abundant as the preceding species, though associated with it. Peculiar to the Western prairie countries.

Zonotrichia querula, Gamb.

Harris's Finch. Baird, General Report on Birds, p. 462.

Same as preceding. Confined to the West, and so far as we yet know, to the country bordering on the Lower Missouri.

Zonotrichia albicollis, Bonap.

White-throated Sparrow. Baird, General Report on Birds, p. 463.

Very abundant throughout the Northwest. Thirteen specimens were collected at different localities.

Junco Oregonus, Sclat.

Oregon Snow Bird. Baird, General Report on Birds, p. 467.

Rather rare along the Missouri, but two specimens having been secured by our party. Its range, according to Prof. Baird, is from the Pacific coast of the United States to the eastern side of the Rocky mountains. Wanders as far east as Fort Leavenworth in winter, and Great Bend of Missouri.

JUNCO CANICEPS, Baird.

GRAY-HEADED SNOW BIRD. Baird, General Report on Birds, p. 468.

Rare along the Missouri, if it occurs at all. The only individuals observed by our party were collected near Laramie peak. Peculiar to the Rocky mountain region.

JUNCO HYEMALIS, Sclat.

BLACK SNOW BIRD. Baird, General Report on Birds, p. 468.

Not uncommon throughout the Northwest.

SPIZELLA MONTICOLA, Baird.

TREE SPARROW. Baird, General Report on Birds, p. 472.

Not rare along the Missouri and other portions of the West. It is also common in the Atlantic States.

SPIZELLA PUSILLA, Bonap.

FIELD SPARROW. Baird, General Report on Birds, p. 473.

The broad prairie country of the West seems to be the favorite resort for a great variety of the sparrows. The above species is quite common throughout the Northwest.

SPIZELLA SOCIALIS, Bonap.

CHIPPING SPARROW. Baird, General Report on Birds, p. 473.

Same as preceding species. Ranges throughout North America from Atlantic to Pacific.

SPIZELLA PALLIDA, Bonap.

CLAY-COLORED BUNTING. Baird, General Report on Birds, p. 474.

Not rare throughout the Prairie country of the Northwest. A species peculiar to the West.

MELOSPIZA MELODIA, Baird.

SONG SPARROW. Baird, General Report on Birds, p. 477.

Not abundant in the Northwest, though common in the Atlantic States.

MELOSPIZA LINCOLNII, Baird.

LINCOLN'S FINCH. Baird, General Report on Birds, p. 482.

Abundant throughout the Northwest. We collected nine specimens at various localities.

MELOSPIZA PALUSTRIS, Baird.

SWAMP SPARROW. Baird, General Report on Birds, p. 483.

Quite rare; probably confined to the country along the Lower Missouri.

CALAMOSPIZA BICOLOR, Bonap.

LARK BUNTING. Baird, General Report on Birds, p. 492.

A species peculiar to the Western plains, and quite abundant in the Northwest.

Euspiza Americana, Bonap.

Black-throated Bunting. Baird, General Report on Birds, p. 494.

Very abundant along the Missouri river and its tributaries. We secured seventeen specimens of this bird.

Guiraca ludoviciana, Sw.

Rose-breasted Grosbeak. Baird, General Report on Birds, p. 497.

Abundant along the wooded bottoms of the Missouri, also Eastern United States.

Guiraca melanocephala, Sw.

Black-headed Grosbeak. Baird, General Report on Birds, p. 498.

This beautiful and somewhat peculiar bird seems to be confined to the Western countries. Its usual places of resort are the wooded bottoms of streams, but it builds its nest in the thickets among the hills.

Guiraca caerulea, Sw.

Blue Grosbeak. Baird, General Report on Birds, p. 499.

Like the preceding, this species is very attractive on account of its color, being a glossy blue. I have never seen it in but one locality, the Loup fork of the Platte, and therefore suspect that it is rare in the West.

Cyanospiza amoena, Baird.

Lazuli Finch. Baird, General Report on Birds, p. 504.

This beautiful little bird is quite abundant in the wooded portions of the Missouri river country. It is also peculiarly Western in its range.

Cardinalis Virginianus, Bonap.

Red Bird. Baird, General Report on Birds, p. 509.

Very common throughout the State of Missouri, where I have seen it in January. It does not occur above Fort Pierre on the Missouri.

Pipilo erythrophthalmus, Vieill.

Ground Robin; Towhee. Baird, General Report on Birds, p. 512.

This species is quite abundant on the wooded bottoms of the Missouri, until we reach a point about latitude 43°, when it seems to be replaced to a certain extent by the succeeding species.

Pipilo Arcticus, Sw.

Arctic Towhee. Baird, General Report on Birds, p. 514.

Near the mouth of Niobrara river this species begins to make its appearance in great numbers, and is found from thence throughout the Northwest. It is peculiarly a Western bird.

PIPILO CHLORURA, Baird.

GREEN-TAILED FINCH. Baird, General Report on Birds, p. 519.

This species must be quite rare in the Western plains. We observed it in but one locality, Laramie peak, where we obtained three specimens. It is also peculiar to the West.

DOLICHONYX ORYZIVORUS, Sw.

BOBOLINK; REED BIRD. Baird, General Report on Birds, p. 532.

One of the most abundant birds on the Western prairies. It is very common at Fort Pierre, though I have never observed it high up toward the sources of the Missouri.

MOLOTHRUS PECORIS, Sw.

COW BIRD. Baird, General Report on Birds, p. 524.

Abundant everywhere throughout the Northwest, visiting our herds of mules and horses, when in camp, by thousands.

AGELAIUS PHOENICEUS, Vieill.

RED-WINGED BLACKBIRD. Baird, General Report on Birds, p. 526.

Like the preceding bird this species is common throughout the Northwest. Nine specimens are included in our Nebraska collection, from different localities.

XANTHOCEPHALUS ICTEROCEPHALUS.

YELLOW-HEADED BLACKBIRD. Baird, General Report on Birds, p. 531.

This species seems to be for the most part a Western bird. It is quite common throughout the Northwest, being found about the marshy lakes on the prairies.

STURNELLA MAGNA, Sw.

MEADOW LARK. Baird, General Report on Birds, p. 535.

I suspect this species does not go above latitude 43° on the Missouri, but is there replaced by an allied species, *S. neglecta*. The only specimens we have seen, were obtained on the Loup fork of the Platte, during the summer of 1857.

STURNELLA NEGLECTA, Aud.

WESTERN LARK. Baird, General Report on Birds, p. 537.

This is one of the most abundant birds on the broad prairie country of the Northwest. It appears early in the spring, and remains late in the fall, greeting the eye of the traveler by its presence, and charming him with its song. It occurs very abundantly in the sage plains, where it finds its choicest places for building its nest and rearing its young. Twenty-two specimens were obtained by our party.

ICTERUS SPURIUS, Bonap.

ORCHARD ORIOLE. Baird, General Report on Birds, p. 547.

Very abundant throughout the Northwest, especially along the wooded bottoms of the

Missouri. We were able to secure twelve specimens at various localities. It is quite widely diffused throughout the United States, from the Atlantic to the Rocky mountains.

ICTERUS BALTIMORE, Daudin.

BALTIMORE ORIOLE. Baird, General Report on Birds, p. 548.

Like the preceding species this beautiful and attractive bird is quite abundant throughout the wooded portions of the Missouri country. It is more common on the numerous islands in the river, from the mouth to Fort Union. It is widely distributed like the preceding.

ICTERUS BULLOCKII, Bonap.

BULLOCK'S ORIOLE. Baird, General Report on Birds, p. 549.

This bird is quite rare, but one specimen having been taken in all our explorations. I think, however, that it occurs occasionally along the Lower Missouri, but seldom passes above Fort Pierre. Has also a wide distribution.

SCOLECOPHAGUS FERRUGINEUS, Sw.

RUSTY BLACKBIRD. Baird, General Report on Birds, p. 551.

I do not think this species is common on the Lower Missouri, and I suspect it is seldom or never seen on the Upper Missouri. We were able to secure but one specimen, and that was observed about twenty miles below Sioux city. It ranges from the Atlantic coast to the Missouri.

SCOLECOPHAGUS CYANOCEPHALUS.

BREWER'S BLACKBIRD. Baird, General Report on Birds, p. 552.

Seems to be widely diffused throughout the Western country. It is not uncommon along the Missouri and its tributaries.

QUISCALUS VERSICOLOR, Vieill.

CROW BLACKBIRD. Baird, General Report on Birds, p. 555.

Not rare along the Missouri. Ranges from the Atlantic to the Rocky mountains.

CORVUS CARNIVORUS, Bartram.

AMERICAN RAVEN. Baird, General Report on Birds, p. 560.

Very abundant throughout the Northwest. Indeed it seems to be the favorite place of resort, on account of the great quantities of game of various kinds which furnish them food. These birds are always seen in the vicinity of large herds of buffalo, and have learned to follow the hunters for hours at a time. In the lonely desert or Bad Lands they will often hover over the traveller, and by their lugubrious croaking conjure up all manner of unpleasant impressions.

Corvus Americanus, Aud.

Common Crow. Baird, General Report on Birds, p. 566.

Very abundant throughout the Northwest. It is confined mostly to the marshy places of the interior, or along the watercourses. Quite widely diffused throughout the North American continent.

Picicorvus Columbianus, Bonap.

Clark's Crow. Baird, General Report on Birds, p. 573.

I have never seen this bird immediately along the Missouri, though it was obtained by Dr. Suckley high up near Milk river. In passing up the valley of the Platte in the summer of 1857, we began to meet with it near Fort Laramie, and found it very abundant in the Laramie range of mountains. From thence to the Black hills and also in the Bad Lands we met with it frequently. It is evidently confined, for the most part, to the rugged and almost inaccessible portions of the West.

Pica Hudsonica, Bonap.

Magpie. Baird, General Report on Birds, p. 576.

One of the most common and familiar birds which the traveller meets with in the far West. I have never observed them below Council bluffs, and from thence to the mountains they increase in numbers. The buffalo country is their favorite region, where they live upon the meat of the buffalo and other game, that may chance to die by the agency of hunters or other causes. I think their favorite breeding-places are in the "Bad Lands" and the small outliers of the Rocky mountains. I think it is confined to the regions west of the Mississippi.

Cyanura macrolophus, Baird.

Long-crested Jay. Baird, General Report on Birds, p. 582.

This fine species of Jay is quite common in the Laramie range of mountains, but quite difficult to obtain. I observed it in only one locality, and with considerable labor collected two specimens. It is always moving, and must be shot on the wing. Confined to the mountain regions of the West.

Perisoreus Canadensis, Bonap.

Canada Jay. Baird, General Report on Birds, p. 590.

We observed this bird only in the mountain regions, but in those localities, very abundant and accessible. In the Laramie range and Black hills are myriads of them. It is quite extensively distributed over the north portion of North America.

Ectopistes migratoria, Sw.

Wild Pigeon. Baird, General Report on Birds, p. 600.

Although occasionally seen throughout the Northwest, I do not think this bird can be

regarded as having a far Western range. On the Lower Missouri it is quite abundant, but on the Upper Missouri it does not meet with its peculiar and favorite food. I have seen small flocks high up on the Yellowstone when the wild berries, which grow there in great abundance, were ripe, but I do not think I have ever seen more than a hundred individuals in a single season. It is doubtless a straggler in the far West.

ZENAIDURA CAROLINENSIS, Bonap.

COMMON DOVE. Baird, General Report on Birds, p. 604.

Is quite common throughout the Northwest. The islands of the Missouri are its favorite breeding-places. A nest on Cedar island was found built without care on the ground in a depression; a second was observed on a tree about ten feet above the ground, constructed with very little care, of a few spires of grass. Distributed throughout the United States from the Atlantic to the Pacific.

TETRAO OBSCURUS, Say.

DUSKY GROUSE. Baird, General Report on Birds, p. 620.

I have seen this fine bird in but one locality, the Laramie range of mountains. We there saw several flocks, from which we managed to shoot a dozen or more. Its flesh is white and exceedingly delicate for food. I am told that it lives in the Black hills, though it was not observed by any of the members of our party. Its range is from the Laramie mountains to the Cascade mountains of Oregon and Washington.

CENTROCERCUS UROPHASIANUS, Sw.

SAGE COCK. Baird, General Report on Birds, p. 624.

This species seems to be confined to the Sage plains of the West. I have never seen it in great abundance. In my wanderings in the valley of the Yellowstone river, during the summer of 1854, I saw but one flock, of about a dozen individuals, and I do not think I have seen more than eighty or a hundred in all. It is said to occur in large numbers in the Green river country. It is confined mostly to the vicinity of the mountains, and seems to be decreasing annually.

PEDIOECETES PHASIANELLUS, Baird.

SHARP-TAILED GROUSE. Baird, General Report on Birds, p. 626.

This bird is seldom seen below Council bluffs. From thence to the mountains it is very abundant, and often supplies the hungry voyager with a delicious meal. In the winter season it may be seen in great numbers sitting upon trees, apparently motionless, and thus they permit the hunter to approach very near them.

CUPIDONIA CUPIDO, Baird.

PRAIRIE HEN. Baird, General Report on Birds, p. 628.

The highest point on the Missouri that I have observed this bird, is the mouth of the

Niobrara river. It may pass up as high as the mouth of White river, though rarely. In the vicinity of Council bluffs it occurs in flocks of myriads, sometimes doing considerable injury to fields of corn.

Ortyx Virginianus, Bonap.

Partridge; Quail. Baird, General Report on Birds, p. 640.

Like the preceding the Quail does not pass far up the Missouri. I think it may occasionally be seen as high up as the mouth of White river, though seldom, and never above that point. Around Council bluffs, Big Sioux, Vermilion and James rivers, &c., it is quite abundant.

Grus Canadensis, Temm.

Sand-hill Crane. Baird, General Report on Birds, p. 655.

Not rare, especially in the sand-hills of Nebraska.

Ardea Herodias, Linn.

Great Blue Heron. Baird, General Report on Birds, p. 668.

Generally distributed throughout the West, along the watercourses.

Botaurus lentiginosus, Steph.

Bittern; Stake Driver. Baird, General Report on Birds, p. 674.

Not uncommon where marshes or lakes are found in the West.

Charadrius Virginicus, Borck.

Golden Plover. Baird, General Report on Birds, p. 690.

Abundant anywhere on the upland prairies of the West, from Fort Pierre to the mountains.

Aegialitis vociferus, Cassin.

Killdeer. Baird, General Report on Birds, p. 692.

Also abundant throughout the country drained by the Missouri river and its tributaries.

Aegialitis montanus, Cassin.

Mountain Plover. Baird, General Report on Birds, p. 693.

Quite abundant in the vicinity of the mountains, where it occurs in large flocks.

Aegialitis melodus, Cab.

Piping Plover. Baird, General Report on Birds, p. 695.

Very abundant on the sand-bars in the broad, shoal channel of the Platte river. I saw them in no other portion of the West.

Recurvirostra Americana, Gm.

American Avoset. Baird, General Report on Birds, p. 703.

This seems to be a rare bird in the West; but two specimens were observed: one of them was killed on the Yellowstone, the other on the Platte.

PHALAROPUS WILSONII, Sab.

WILSON'S PHALAROPE. Baird, General Report on Birds, p. 705.

Quite abundant during the spring months, along the marshy bottoms and lakes of the Lower Missouri.

PHILOHELA MINOR, Gray.

AMERICAN WOODCOCK. Baird, General Report on Birds, p. 709.

Very rare south of the Missouri, though not uncommon near Council bluffs in the Northwest. We obtained one specimen near the mouth of Loup fork.

GALLINAGO WILSONII, Bonap.

ENGLISH SNIPE. Baird, General Report on Birds, p. 710.

We saw this well-known bird quite rarely. A few were killed in low, marshy places, near the mouth of Loup fork, others in the Black hills.

TRINGA WILSONII, Nuttall.

LEAST SANDPIPER. Baird, General Report on Birds, p. 721.

Observed in the Platte valley. Probably rare.

TRINGA BONAPARTII, Schlegel.

BONAPARTE'S SANDPIPER. Baird, General Report on Birds, p. 722.

More or less abundant throughout the watercourses of the Northwest.

EREUNETES PETRIFICATUS, Ill.

SEMIPALMATED SANDPIPER. Baird, General Report on Birds, p. 724.

Three specimens of the above species were collected along the Loup fork, and one near Bijoux hills on the Missouri river.

GAMBETTA MELANOLEUCA, Bonap.

TELL-TALE; STONE SNIPE. Baird, General Report on Birds, p. 731.

More or less common along the watercourses of the West.

RHYACOPHILUS SOLITARIUS, Bonap.

SOLITARY SANDPIPER. Baird, General Report on Birds, p. 733.

Abundant along the Missouri river and its tributaries.

TRINGOIDES MACULARIUS, Gray.

SPOTTED SANDPIPER. Baird, General Report on Birds, p. 735.

Abundant along the watercourses in the West.

ACTITURUS BARTRAMIUS, Bonap.

FIELD PLOVER. Baird, General Report on Birds, p. 737.

This bird is met with all over the high plains of the West, oftentimes at a great distance from any of the principal watercourses. It also rears its young on the upland prairies.

Limosa fedoa, Ord.

Marbled Godwit. Baird, General Report on Birds, p. 740.

Not very common in the West, as far as our observations extended. Two specimens were taken by us, one at Council bluffs, and the other at Fort Union, Nebraska.

Numenius Borealis, Latham.

Esquimaux Curlew. Baird, General Report on Birds, p. 744.

Not uncommon high up toward the sources of the Missouri. Our specimens were taken near Fort Union.

Numenius longirostris, Wilson.

Long-billed Curlew. Baird, General Report on Birds, p. 743.

Very abundant on the upland prairies of the far West, where it feeds in considerable numbers.

Porzana Carolina, Vieill.

Common Rail. Baird, General Report on Birds, p. 749.

One specimen was secured near Durion's hills, below Niobrara river. Very rare.

Fulica Americana, Gmelin.

Coot. Baird, General Report on Birds, p. 751.

Not uncommon throughout the Northwest.

Cygnus buccinator, Rich.

Trumpeter Swan. Baird, General Report on Birds, p. 758.

Seen at certain seasons of the year in large flocks throughout the Northwest. A few breed in the valley of the Yellowstone.

Bernicla Canadensis, Boie.

Canada Goose. Baird, General Report on Birds, p. 764.

Abundant on the Yellowstone in the spring and autumn. A few breed along that river.

Anas boschas, Linn.

Mallard. Baird, General Report on Birds, p. 774.

Abundant along the Missouri and its tributaries.

Dafila acuta, Jenyns.

Sprig-tail; Pin-tail. Baird, General Report on Birds, p. 776.

Generally diffused throughout the West.

Nettion Carolinensis.

Green-winged Teal. Baird, General Report on Birds, p. 778.

Very abundant throughout the valleys of the Missouri and its larger tributaries.

QUERQUEDULA DISCORS, Steph.

BLUE-WINGED TEAL. Baird, General Report on Birds, p. 779.

Distribution same as last.

SPATULA CLYPEATA, Boie.

SHOVELLER. Baird, General Report on Birds, p. 781.

One specimen only collected, near the mouth of Iowa creek. Very rare.

MARECA AMERICANA, Stephens.

BALDPATE. Baird, General Report on Birds, p. 783.

Quite rare. One specimen taken in the Missouri river near Bijoux hills.

AIX SPONSA, Boie.

SUMMER DUCK. Baird, General Report on Birds, p. 785.

Abundant throughout the West.

ERISMATURA RUBIDA, Bonap.

RUDDY DUCK. Baird, General Report on Birds, p. 811.

Collected near mouth of the Platte and in the valley of White river. Not abundant.

MERGUS AMERICANUS, Cass.

SHELDRAKE. Baird, General Report on Birds, p. 813.

More or less abundant throughout the Upper Missouri country.

LOPHODYTES CUCULLATUS, Reich.

HOODED MERGANSER. Baird, General Report on Birds, p. 816.

One specimen was collected from the Yellowstone river.

LARUS DELAWARENSIS, Ord.

RING-BILLED GULL. Baird, General Report on Birds, p. 846.

Very rare, but one specimen secured.

STERNA FRENATA, Gambel.

LEAST TERN. Baird, General Report on Birds, p. 864.

Not abundant, though widely distributed along the Western streams. We collected it from the Platte and Yellowstone valleys.

HYDROCHELIDON PLUMBEA, Wils.

SHORT-TAILED TERN. Baird, General Report on Birds, p. 864.

One specimen collected on the Loup fork.

PODICEPS CALIFORNICUS, Heermann.

CALIFORNIA GREBE. Baird, General Report on Birds, p. 896.

Quite rare. Two specimens collected in 1856, between Fort Union and Fort Berthold.

CHAPTER XVII.

REPTILES, FISHES, AND RECENT SHELLS.

A. Reptiles.

TESTUDINATA.	
TRIONYX,	Yellowstone river.
EMYS ELEGANS,	" "
EMYS,	Mouth of Powder river.
CISTUDO,	" " "
OPHIDIA.	
GAUDISONA LECONTEI, Cope,	Yellowstone river.
CROTALUS TERGEMINUS, Say,	" "
THAMNOPHIS SIRTALIS var. PARIETALIS, B. & G.,	Loup fork.
THAMNOPHIS HAYDENI, Cope,	Sand hills.
TROPIDONOTUS SIPEDON,	Yellowstone river.
HETERODON NASICUS, B. & G.,	Sand hills of Loup fork.
PITYOPHIS SAYI, B. & G.,	" " "
LAMPROPELTIS MULTISTRIATA, Kenn.,	Fort Benton on the Missouri.
LAMPROPELTIS SAYI, Cope,	Missouri river.
NATRIX OBSOLETA, Cope,	Missouri river to valley of the Platte.
NATRIX RHINOMEGAS, Cope,	" " " "
BASCANIUM FLAVIVENTRIS, B. & G.,	Head of Loup fork.
LIOPELTIS VENALIS, B. & G.,	Yellowstone river.
SAURIA.	
SCELOPORUS CONSOBRINUS, B. & G.,	Sand hills, valley of the Platte.
SCELOPORUS GRACIOSUS, B. & G.,	" " "
HOLBROOKIA MACULATA, Girard,	" " "
HOLBROOKIA DOUGLASII,	" " "
CNEMIDOPHORUS SEXLINEATUS, Dum., Bibr.,	" " "
PLESTIODON LEPTOGRAMMUS, Baird,	" " "
PLESTIODON MULTIVIRGATUS, Hallow.,	" " "
PLESTIODON INORNATUS, Baird,	" " "
PLESTIODON SEPTENTRIONALIS, Baird,	" " "
BATRACHIA.	
RANA HALECINA, Kalm,	
HELECETES TRISERIATUS, Max.,	Mouth of Yellowstone.
BUFO AMERICANUS, Lec.,	Along the Missouri river.
BUFO COGNATUS, Say,	" " "

BUFO WOODHOUSEI, Grd.,	Along the Missouri river.
SIREDON LICHENOIDES,	Sand hills, valley of the Platte.
AMBLYSTOMA LURIDUM, Baird,	" " "

B. Fishes.

PERCOIDS.

STIZOSTEDION BOREUS, Girard,	Fort Union, Missouri river.

SCIAENOIDS.

HAPLOIDONOTUS GRUNNIENS, Raf.,	Milk river.

GASTERASTEOIDS.

APELTES INCONSTANS, Gill.,	Yellowstone river.

CYPRINOIDS.

PIMEPHALES FASCIATUS, Girard,	Milk river, Upper Missouri.
HYBOGNATHUS ARGYRITES, Girard,	" " "
HYBOGNATHUS EVANSI, Girard,	Fort Pierre.
RHINICHTHYS DULCIS, Gill,	Sweetwater river.
PLATYGOBIO (POGONICHTHYS, Girard) COMMUNIS, Gill,	Milk river.
GOBIO GELIDUS, Girard,	"
LEUCOSOMUS DISSIMILIS, Girard,	"
LEUCOSOMUS MACROCEPHALUS, Girard,	Fort Pierre.
NOCOMIS NEBRASCENSIS, Girard,	Sweetwater river.
SEMOTILUS SPECIOSUS, Girard,	Platte river.
PLARGYRUS BOWMANI, Girard,	Sweetwater river.

CATASTOMOIDS.

CATASTOMUS SUCKLII, Girard,	Milk river.
ACOMUS LACTARIUS, Girard,	"
ACOMUS GRISENS, Girard,	Platte river.
PTYCHOSTOMUS HAYDENI, Girard,	Yellowstone river.
CARPIODES DAMALIS, Girard,	Fort Pierre.

HYODONTOIDS.

HYODON TERGISUS, Lesueur,	Fort Sarpy, Yellowstone.

SILUROIDS.

ICTALURUS OLIVACEUS, Gill,	Yellowstone river.
NOTURUS FLAVUS, Raf.,	" "

ACIPENSEROIDS.

SCAPHYRHYNCHOPS PLATYRHYNCHUS, Gill (SCAPHYRHYNCHUS RAFINESQUII, Heckel),	Upper Missouri.

POLYODONTOIDS.

POLYODON FOLIUM, Lac.,	Fort Pierre.

C. Recent Mollusca.

Recent shells are not abundant on the Missouri except in the streams that flow from the North. Terrestrial shells seldom occur above the mouth of the Niobrara river in a living condition. The waters of the Missouri to a point above the mouth of Milk river are so turbid that molluscous life does not exist, but in the little streams that issue from the mountains, a few *Unios* are found. The rivers that flow from the north, James, Vermilion and Big Sioux, abound with *Unionidæ*, and other freshwater shells. Vast numbers of shells are found in the alluvial deposits throughout the Northwest. In the bank of a little stream about two miles below the mouth of the Big Sioux, called Clay creek, there is a bed of shells about fifteen feet above the bed of the creek and six feet below the surface, three feet in thickness, composed almost entirely of different species of freshwater mollusca, *Unio*, *Paludina*, *Physa*, *Cyclas*, *Pupa*, very finely preserved, many of them delicate and friable, but as perfect as when living. In the alluvial just above the shells, are great numbers of bones, probably belonging to the buffalo, and over these are growing large forest trees, elm, black walnut, oak, &c. Throughout the great thickness of yellow marl, which has been deposited along the Missouri, from the Niobrara to the mouth of the former river, are disseminated large quantities of terrestrial and fluviatile shells, so far as is yet known, mostly identical with recent species. Near Fort Berthold, the fine vegetable material washed on the shores of the river contains myriads of minute *Helices*, *Pupas*, &c. From my collections in this region, Mr. Binney has described two new species of *Pupa*, *P. Nebraskana*, and *P. Blandi*. In the Black hills very few living shells were observed, but the alluvial soil composing the banks of the little streams is filled with freshwater and land shells, from which a new species, *Helix Cooperi*, was described by Mr. Binney. The freshwater shells were kindly examined by Mr. Lea of Philadelphia, and in regard to the above collection and a series obtained by Mr. Kennicott from the Red river of the North, Mr. Lea made the following remarks before the Philadelphia Academy.

"It is not to be understood that either of these collections, made under adverse circumstances, and at times of great personal danger, should be full representatives of this branch of the fauna of these countries. But they are sufficient to prove that zoological life, so far as represented by molluscs, is nearly, if not quite the same, as that of the Ohio river basin, as well as that of the Missouri river and a part of the Lower Mississippi and Red river of the South. The knowledge of a part of the species from these remote districts proves to us the wide-spread distribution of the same species, as we find every one of them in the Ohio river at Cincinnati, Marietta, and Pittsburg, and this is the more remarkable, as the waters of the Red river of the North are embraced in a different system of drainage, flowing as they do into Hudson's bay at about 52° north latitude. Here is seen an immense

area of country producing in its waters nearly the same life as regards the molluscs, a fact highly interesting to the zoologist."

To Mr. W. G. Binney were transmitted the land shells, which were examined by him with great care. I quote the following remarks from his letter: "These shells are all of value, as they form the first contribution to our knowledge of the species found in those regions. They are, however, for the most part alluvial. *Succinea Haydeni* is the only perfectly fresh species, the animal being preserved in alcohol.

"*Helix costata* was found in myriads, probably the contribution of many small streams above. Of the previously known species it is the most interesting, having been noticed previously in few localities and in small numbers. If any argument were needed to establish the point of *H. minuta* (Say), being identical with the European *H. pulchella* (Mull.), it might be found in the fact of the ribbed variety being also found in this country."

The following catalogue comprises all the freshwater and land shells known to us on the Upper Missouri:

FLUVIATILE SHELLS.

1. UNIO ALATUS, Say,	Big Sioux river.
2. UNIO LEVISSISSIMUS, Lea,	" "
3. UNIO LUTEOLUS, Lam.,	" "
4. UNIO ASPERIMUS, Lea,	" "
5. UNIO RECTUS, Lea,	" "
6. UNIO ELEGANS, Lea,	James river.
7. UNIO ZIGZAG, Lea,	White-earth river.
8. UNIO ANADONTOIDES, Lea,	James river.
9. MAGARITANA COMPLANATA, Lea,	Fort Clark, in Missouri.
10. ANADONTA FERUSSACIANA, Lea,	White river, Nebraska.
11. LYMNEA ELODES, Say,	Mouth of Big Sioux river.
12. LYMNEA NUTTALLIANA, Lea,	" " "
13. LYMNEA HUMILIS, Say,	" " "
14. LYMNEA HAYDENI, Lea,	" " "
15. LYMNEA KIRTLANDIANA, Lea,	" " "
16. LYMNEA UMBROSA, Say,	Grindstone creek, Nebraska Territory.
17. LYMNEA LUBRICOIDES, Lea,	" " " "
18. LYMNEA PHILADELPHICA, Lea,	" " " "
19. PLANORBIS BICARINATUS, Say,	Mouth of Big Sioux river.
20. PLANORBIS TRIVOLVIS, Say,	" " "
21. PLANORBIS LENTUS, Say,	" " "
22. PLANORBIS PARVUS, Say,	" " "

23. PLANORBIS CAMPANULATUS, Say,	Mouth of Big Sioux river.
24. PHYSA HETEROSTROPHA,	" " "
25. PHYSA INTEGRA? Hald.,	" " "
26. PHYSA ELONGATA, Say,	" " "
27. PHYSA AMPULARIA, Say,	" " "
28. PSIDIUM—?	Grindstone creek.
29. CYCLAS—?	" "
30. CYCLAS—?	" "
31. AMNICOLA PORATA, Say,	Fort Berthold.
32. AMNICOLA LAPIDARIA, Say,	"

LAND SHELLS.

33. HELIX MINUSCULA, Binney,	Council bluffs, Nebraska Territory.
34. HELIX LINEATA, Say,	" " "
35. HELIX STRIATELLA, Anthony,	" " "
36. HELIX INFLECTA, Say,	" " "
37. HELIX HIRSUTA, Say,	" " "
38. HELIX SOLITARIA, Say,	" " "
39. HELIX ALTERNATA, Say,	" " "
40. HELIX ELEVATA, Say,	" " "
41. HELIX FALLAX, Say,	" " "
42. HELIX CONCAVA, Say,	" " "
43. HELIX LIGERA, Say,	" " "
44. HELIX PROFUNDA, Say,	Near Fort Leavenworth, Kansas Territory.
45. HELIX MULTILINEATA, Say,	" " "
46. HELIX MONODON, Rackett,	" " "
47. HELIX PULCHELLA, Mull.,	" " "
48. HELIX COSTATA, Mull.,	" " "
49. HELIX ARBOREA, Say,	Drift on the Missouri near Fort Berthold.
50. HELIX CHERESINA, Say,	" " "
51. HELIX ELECTRINA, Gould,	" " "
52. HELIX COOPERI, Binney,	Black hills, Nebraska Territory.
53. PUPA NEBRASKANA, W. G. Binney,	Fort Berthold, Nebraska Ter.
54. PUPA BLANDI, W. G. Binney,	" "
55. PUPA ARMIGERA, Say,	" "
56. PUPA PENTODON, Say,	Council bluffs, "
57. PUPA MODESTA, Say,	" "
58. PUPA BADIA, Adams,	" "

59. Bulimus lubricus, Mull., Fort Berthold, on Missouri.
60. Succinea venusta, Say, Yellowstone.
61. Succinea retusa, Lea, "
62. Succinea Haydeni, W. G. Binney, "
63. Succinea lineata, W. G. Binney, Fort Union and Yellowstone.
64. Succinea Nuttalliana, Lea, Fort Union.
65. Succinea obliqua, Say, Fort Berthold, Nebraska Ter.

CHAPTER XVIII.

BOTANY.

BY GEORGE ENGELMANN, M.D.

RANUNCULACEÆ.

Clematis Virginiana, Linn. Very abundant from the mouth of the Missouri river to Council bluffs.

Clematis ligusticifolia, Nutt. Fort Pierre to the mountains. Very abundant about Fort Union, Fort Laramie, and head of the Platte.

Pulsatilla patens, D. C. This plant is called by the Indians the harbinger of spring. I saw it on the south side of Bear Peak, March 9, 1855, just coming into bloom. It is found quite abundantly in the White river valley; also in the sandhills of Loup fork.

Anemone Pennsylvanica, Linn. Abundant from the mouth of the Missouri to the mountains, though most common below latitude 43°.

Anemone Caroliniana, Walt. Quite common around Council bluffs to Niobrara river.

Anemone cylindrica, Gray. This plant is quite rare; only a few individuals were seen near the mouth of the Big Sioux river, and on Loup fork.

Ranunculus repens var. *Marylandicus*, Torr. & Gray. Low, wet places on the Upper Missouri.

Ranunculus Pennsylvanicus, Linn. Council bluffs, Niobrara, Platte valley.

Ranunculus recurvatus, Poir. Mouth of the Missouri to Niobrara river; also sparingly in White river valley.

Ranunculus abortivus, Linn. Wet and sandy places to Niobrara; sparingly to the mountains.

Ranunculus sceleratus, Linn. Not rare throughout the Upper Missouri country.

Ranunculus glaberrimus, Hook. The only locality in which I ever saw this plant was at Grindstone hills, near Bad Lands, where it was in bloom on the 9th of April.

Ranunculus cymbalaria, Pursh. Seen on the Yellowstone and Missouri.

Ranunculus aquatilis, Linn. Very abundant in the White river valley, in the streams, and little lakes.

Myosurus minimus, Linn. Missouri bottoms, opposite St. Joseph's; also on the upland prairie near Fort Pierre.

Aquilegia Canadensis, Linn. Does not extend above Council bluffs or the Big Sioux.

Isopyrum biternatum, Torr. & Gray. Seen sparingly as far up the Missouri as the mouth of the Platte.

Delphinium tricorne, Mich. Extends to the mouth of the Big Sioux; range to Niobrara, in latitude 43°.

Delphinium azureum, Mich. Abundant on the open prairies to the mountains.

Delphinium virescens, Nutt. Fort Pierre.

Thalictrum cornuti, Linn. Not rare to mountains.

Thalictrum dioicum, Linn. Abundant to Niobrara river.

Hydrastis Canadensis, Linn. Found only in the carboniferous limestone region to Council bluffs; perhaps rarely to Big Sioux river.

Actea rubra, Bigelow. Council bluffs.

Aconitum napellus, Linn. Laramie mountains, August 24th.

MAGNOLIACEÆ.

Liriodendron tulipifera, Linn. In Eastern Kansas.

ANONACEÆ.

Asimina triloba, Dunal. Common Papaw. Extends up the Missouri to the mouth of the Big Sioux river.

MENISPERMACEÆ.

Menispermum Canadensis, Linn. Most abundant in the limestone regions to Council bluffs; seen rarely on wooded banks to the Yellowstone.

BERBERIDACEÆ.

Berberis aquifolium, Pursh. A very abundant shrub in the Laramie range of hills and Black hills.

Podophyllum peltatum, Linn. Abundant along the lower part of the Missouri river, gradually ceasing at the mouth of the Platte.

NELUMBIACEÆ.

Nelumbeum luteum, Willd. Lower portion of the valley of the Platte, and on the broad, wet bottoms about Omaha city. It is now quite rare, on account of the great use of both roots and seeds for food by the Omaha, Otoe, and Pawnee Indians.

NYMPHEACEÆ.

Nymphea odorata, Ait. Found by Dr. Cooper in Kansas.

PAPAVERACEÆ.

Argemone Mexicana, Linn. Found only at Bellevue, Neb. Ter.; fine yellow flowers.

Argemone hispida, Gray. Bad Lands, White river, Loup fork, Fort Laramie.

Sanguinaria Canadensis, Linn. Rich woods about Council bluffs.

FUMARIACEÆ.

Corydalos aurea, Willd. Not seen on the bottoms to mountains.

Dicentra cucullaria, D. C. In shady woods to mouth of Big Sioux.

CRUCIFERÆ.

Nasturtium palustre, D. C. Not uncommon to mountains.

Nasturtium obtusum, Nutt. On the Upper Missouri and Yellowstone.

Nasturtium sinuatum, Nutt. Fort Clark, Upper Missouri.

Nasturtium sessiliflorum, Nutt. Along Missouri.

Nasturtium limosum, Nutt. Along low bottoms near to Council bluffs.

Nasturtium calycinum,* Engelmann. N. sp. Annuum erectum seu diffusum, hirsutulum; foliis caulinis anguste oblongis sinuatis seu subpinnatifidis basi auriculata arcte sessilibus vel semi amplexicaulibus; racemis confertifloris demum elongatis; pedicellis flore flavido et silicula ovoidea acuta parva hispidula cum stylo gracilis vix longioribus; calyce persistente. In aspect as well as in the style (fully a line long on a silicle 1½ line in length), this species resembles some *Vesicariae*, but the numerous seeds are those of a *Nasturtium*. The stem is about a foot high, often much branched and diffuse. The ovate lanceolate acutish sepals commonly persist until the valves of the pod have fallen. The pubescence of the pod consists of very short and pointed thick-based simple hairs. (A. Gray.) Sandy bottoms of the Yellowstone river; Fort Sarpy to Fort Union.

Arabis Canadensis, Linn. Common along the Missouri to Fort Union.

Arabis hirsuta, Scop. Fort Union and Bad Lands.

Arabis laevigata, D. C. Shady woods to mouth of Platte.

Arabis dentata, Torr. and Gray. Council bluffs.

Sisymbrium canescens, Nutt. Fort Pierre and the Yellowstone.

Dentaria laciniata, Muhl. Shady woods around Council bluffs.

Erysimum asperum, D. C. Abundant on the high prairies to Fort Pierre and Fort Union.

Erysimum cheiranthoides, Linn. Yellowstone and Bad Lands.

Stanleya pinnatifida, Nutt. Abundant on the marl banks near Niobrara River, Fort Pierre, rarely on the Yellowstone.

Stanleya integrifolia, James. Dr. Gray thinks it is a different form of last species.

* First published in Preliminary Report of Explorations in Nebraska and Dakota, 1855, '6, and '7; Lieut. G. K. Warren, T. E. Catalogue of Plants.

Vesicaria ludoviciana, D. C. Sterile hills, Fort Pierre and Yellowstone.

Vesicaria alpina, Nutt. Same as preceding.

Vesicaria didymocarpa, Hook. Bad Lands.

Sinapis nigra, Linn. About old houses and cultivated fields, Council bluffs and Fort Pierre.

Capsella bursa-pastoris, Linn. Same as preceding.

Draba micrantha, Nutt. Bad Lands.

Draba Caroliniana, Walt. Council bluffs.

Draba brachycarpa, Nutt. Lower Missouri.

Lepidium ruderale, Linn. Along Missouri to mountains.

Lepidium Virginicum, Linn. Fort Pierre and Yellowstone.

Lepidium intermedium, Gray. Bad Lands of the Judith, Blackfoot country.

Thelypodium integrifolium. Very abundant near saline lakes in sand hills of Loup fork.

CAPPARIDACEÆ.

Cleome integrifolia, Torr. and Gray. Bad Lands, Fort Union, Yellowstone, Bad Lands of Judith, Platte valley, Fort Laramie. Not a generally diffused plant, but growing abundantly in localities.

Polanisia uniglandulosa, Gray. First seen on gravelly hills about Fort Pierre; also on Loup fork.

Cristatella Jamesii, Torr. and Gray. Gravelly hills on Loup fork, August 1st.

VIOLACEÆ.

Viola palmata, Linn. Fort Pierre.

Viola cucullata, Sit. Fort Pierre.

Viola Nuttallii, Pursh. Bad Lands.

Viola Canadensis, Linn. Fort Pierre.

Viola tricolor, Linn. Council bluffs.

Viola delphinifolia, Nutt. Prairies around Council bluffs.

CISTACEÆ.

Helianthemum Canadense, Michx. Black hills, August 24th.

Lechea major, Michx. Sand hills, Loup fork.

Lechea minor, Lam. " "

CARYOPHYLLACEÆ.

Silene Drummondi, Hook. Loup fork.

Silene antirrhina, Linn. Council bluffs.

Silene stellata, Ait. Dixon's bluffs.

Alsine Michauxi, Fenzl. Mouth Big Sioux.

Cerastium nutans, Raf. White river, Bad Lands.

Cerastium arvense, Linn. Council bluffs.

Moehringia lateriflora, Linn. Along Missouri to Council bluffs.

Paronychia sessiliflora, Nutt. Fort Union, Laramie peak, Black hills.

Stellaria longipes, Goldie. Council bluffs.

Arenaria Franklini, Douglass. Laramie mountains, August 24th.

Paronychia sessiliflora, Nutt. Elkhorn prairie, Bad Lands of the Judith, Blackfoot country, August 22d.

Paronychia Jamesii, Torr. Black hills, September 15th.

PORTULACACEÆ.

Portulaca oleracea, Linn. On saline clay soil, Teton river, near Fort Pierre; also near base of Black hills (indigenous).

Claytonia Virginica, Linn. Rocky woods, as high up the Missouri as Council bluffs.

Talinum parviflorum, Nutt. Sand hills on Loup fork.

MALVACEÆ.

Abutilon Avicennae, Gaertn. Naturalized near Council bluffs.

Malvastrum coccineum, Gray. Makes its appearance on the Missouri about latitude 43°, and continues to the mountains.

Callirhoe macrorhiza, Gray. Loup fork, July 22d.

Callirhoe involucrata, Gray. Platte river.

TILIACEÆ.

Tilia Americana, Linn. Abundant to Big Sioux; seen sparingly to mouth of Niobrara river, where it ceases.

LINACEÆ.

Linum rigidum, Pursh. Throughout the prairie portion of the Upper Missouri.

Linum perenne, Linn. Fort Pierre and Fort Union.

Linum Bootti, Planchon. Found by Dr. Cooper in Kansas.

GERANIACEÆ.

Geranium caespitosum, James. Black hills and Laramie mountains.

Geranium maculatum, Linn. Common to Niobrara.

Geranium Carolinianum, Linn. Mouth of Big Sioux.

OXALIDACEÆ.

Oxalis stricta, Linn. Generally diffused.

Oxalis violacea, Linn. Rich prairies and cultivated fields around Council bluffs; seen nearly as high as Niobrara in full bloom, June 20th, 1857.

Oxalis corniculata, Linn. Upper Missouri.

BALSAMINACEÆ.

Impatiens pallida, Nutt. Shady woods to mountains.

Impatiens fulva, Nutt. Council bluffs and Big Sioux.

RUTACEÆ.

Xanthoxylum Americanum, Mill. Woody bottoms and islands of the Missouri, to Fort Pierre.

Ptelia trifoliata, Linn. Around Council bluffs.

ANACARDIACEÆ.

Rhus glabra, Linn. Council bluffs, White river valley.

Rhus copallina, Linn. Abundant in Missouri and Kansas.

Rhus toxicodendron, Linn. Abundant in woody places to the mountains.

Rhus aromatica, Ait. Along Missouri.

Rhus trilobata, Nutt. First makes its appearance about latitude 43°, and occurs abundantly on sterile hills to the mountains.

VITACEÆ.

Vitis cordifolia, Michx.

Vitis riparia, Michx. Banks of Missouri, Bellevue, N. T.

Vitis indivisa, Willd. Big Sioux river.

Ampelopsis quinquefolia, Michx. Very common in woody bottoms throughout the country, but grows most luxuriant in the rich woods from the mouth of the Missouri to Big Sioux, where it often so clothes old dry trees that they seem still alive.

RHAMNACEÆ.

Ceanothus Fendleri. Laramie mountains.

Ceanothus velutinus, Douglas. Black hills.

Ceanothus sanguineus, Pursh. Mouth of White river.

Ceanothus ovalis, Bigelow, var. *pubescens.* Common on the cretaceous hills below Fort Pierre; also in the sand hills of Loup fork, on the Niobrara river.

Rhamnus lanceolatus, Pursh. Council bluffs.

CELASTRACEÆ.

Celastrus scandens, Linn. Along Missouri to Fort Union.

Euonymus atropurpureus, Jacq. Woody bottoms to Fort Union.

Euonymus Americanus, Linn. Mouth of Platte.

SAPINDACEÆ.

Staphylea trifolia, Linn. Council bluffs.

Aesculus glabra, Willd. Missouri bottoms to Big Sioux river.

Acer glabrum, Torr. Laramie mountains, August 24th.

Acer dasycarpum, Ehrhart. Bellevue, Nebraska.

Acer rubrum, Linn. Highest limit on Missouri, latitude 42°.

Acer saccharinum, Wang. Limestone regions of Kansas and southern portion of Nebraska.

Negundo aceroides, Moench. One of the few trees which extend to the mountains.

POLYGALACEÆ.

Polygala alba, Nutt. On sterile hills to Fort Union.

Polygala verticillata, Linn. Moist places on prairies, Fort Pierre, Bad Lands.

Polygala senega, Linn. Council bluffs.

LEGUMINOSÆ.

Vicia Americana, Muhl. Upper Missouri generally.

Lathyrus linearis, Nutt. Upper Missouri generally.

Lathyrus polymorphus, Nutt. White river valley.

Lathyrus venosus, Muhl. Rich bottoms, Big Sioux.

Phaseolus pauciflorus, Benth. Bad Lands.

Amphicarpæa monoica, Nutt. White river valley, Fort Clark.

Apios tuberosa, Moench. Along sandy woody bottoms of Missouri. A species of mouse gathers large numbers of the tubers of this plant for his winter store. These "cachés" (as they are called) are eagerly sought by the squaws, and the tubers taken and used as food. I have seen several bushels of the roots in a single lodge. Cooked with buffalo meat they make a very palatable dish.

Glycyrrhiza lepidota, Nutt. Diffused generally.

Psoralea lanceolata, Pursh. From Bellevue to Yellowstone.

Psoralea floribunda, Nutt. Big Sioux river to Bad Lands.

Psoralea campestris, Nutt. Bad Lands.

Psoralea argophylla, Pursh. A most beautiful plant, covering the plains as with silvery velvet. Big Sioux to mountains.

Psoralea cuspidata, Pursh. Fort Pierre to Bad Lands.

Psoralea esculenta, Pursh. Affords the Indians a very nourishing farinaceous root, upon which they subsist almost entirely in the spring and early summer months, when game is scarce. It is also a great favorite of the grizzly bear.

Psoralea digitata, Nutt. Sand hills on Loup fork.

Amorpha fruticosa, Linn. A common shrub, above Missouri to mountains.

Amorpha canescens, Nutt. Very abundant on the upland prairies, Loup fork, and Niobrara river.

Amorpha nana, Nutt. Fort Laramie and high up the Missouri.

Dalea aurea, Nutt. Bad Lands.

Dalea alopecuroides, Willd. Big Sioux river.

Dalea laxiflora, Pursh. Fort Pierre to the Yellowstone.

Petalostemum candidum, Mich. Big Sioux river.

Petalostemum multiflorum, Nutt. Fort Pierre to Bad Lands.

Petalostemum violaceum, Mich. Upper Missouri to Bad Lands.
Petalostemum villosum, Nutt. Bad Lands; also sand hills on Loup fork.
Petalostemum macrostachyium, Torr. Sand hills along the Loup fork and Niobrara.
Trifolium stoloniferum, Muhl. Bad Lands.
Trifolium pratense, Linn. Lower Missouri.
Trifolium repens, Linn. Lower Missouri.
Hosackia Purshiana, Benth. Sandy bottoms of Missouri.
Astragalus hypoglottis, Linn. White river to Bad Lands.
Astragalus gracilis, Nutt. Bad Lands to the Yellowstone.
Astragalus striatus, Nutt. Fort Pierre to Bad Lands, covering prairies like clover fields.
Astragalus Missouriensis, Nutt. Fort Pierre to Fort Union.
Astragalus caryocarpus, Ker. Fort Pierre to Bad Lands.
Astragalus Plattensis, Nutt. Fort Pierre.
Astragalus Canadensis, Linn. Fort Pierre to Bad Lands.
Astragalus racemosus, Pursh. Abundant in the sandy bottoms of Missouri; Cedar island.
Astragalus mollissimus, Torr. Niobrara river, August 18th.
Astragalus Drummondi, Douglass. Sterile hills around Fort Union.
Astragalus adsurgens, Pall. James river.
Phaca caespitosa, Nutt. Bad Lands.
Phaca longifolia, Nutt. Bad Lands.
Phaca pectinata, Hook. Upland prairies on the Yellowstone river; abundant.
Phaca elongata, Hook. Fort Pierre to Fort Union.
Phaca bisulcata, Hook. Fort Union.
Orytropis Lamberti, Pursh. Very abundant on prairies around Big Sioux and Niobrara rivers.
Oxytropis splendens, Douglass. James river.
Homalobus multiflorus, Nutt. Big Sioux to Bad Lands.
Kentrophyta montana, Nutt. Abundant in sandy river-bottoms on the Yellowstone.
Hedysarum boreale, Nutt. Abundant; mouth of Yellowstone.
Desmodium Canadense, D. C. Fort Clark.
Desmodium Dillenii, Darl. Big Sioux river.
Desmodium paniculatum, D. C. Bellevue, W. T.
Desmodium nudiflorum, D. C. Bellevue, W. T.
Lespedeza capitata, Michx. Abundant on the rich bottoms about Council bluffs, Big Sioux.
Lespedeza hirta, Ell. On Missouri.

Crotalaria sagittalis, Michx. Big Sioux river.
Lupinus pusillus, Pursh. Common on the Yellowstone.
Lupinus ornatus, Douglass. Niobrara river, August 18th.
Lupinus decumbens, Torr. Laramie mountains, August 24th.
Tilia Americana, Linn. Abundant to Big Sioux; seen sparingly to mouth of Niobrara, where it ceases.
Lupinus perennis, Linn. Platte valley.
Lupinus—? Bad Lands of the Judith.
Thermopsis rhombifolia, Nutt. From Council bluffs to Fort Pierre; Bad Lands, &c.
Sophora sericea, Nutt. White river valley; Fort Pierre.
Gleditschia tricanthus, Linn. Occurs as high on the Missouri as Big Sioux.
Cercis Canadensis, Linn. Same as preceding.
Cassia Chaemacrista, Linn. Sandy bottoms of Missouri, from Council bluffs to White river.
Desmanthus brachylobus, Benth. Council bluffs and Platte valley; rich bottoms.
Schrankia uncinata, Willd. Gravelly hills on the Upper Missouri generally.
Gymnocladus Canadensis, Lam. Abundant in woody bottoms to Big Sioux.
Baptisia leucophea, Nutt. Platte valley.
Baptisia leucantha, Torr. and Gray. Lower Platte river, June 25th.

ROSACEÆ.

Prunus Americana, Marsh. Fort Pierre.
Prunus pumila, Linn. Abundant in the sand hills of Loup fork; along Missouri river near Little Soldier's camp.
Prunus serotina, Ehrh. Council bluffs.
Prunus Virginiana, Linn. Generally diffused.
Gillenia stipulacea, Nutt. Mouth of Big Sioux.
Gillenia trifoliata, Moench. Mouth of Big Sioux.
Agrimonia eupatoria, Linn. Bellevue, N. T.
Agrimonia parviflora, Ait. Around Fort Union.
Spiræa opulifolia var. *pauciflora*. Black hills, September 3d.
Spiræa betulafolia var. *corymbosa*. " "
Cercocarpus parvifolius, Michx. Laramie mountains, August 20th.
Horkelia Gordoni. Laramie mountains.
Chaemorhodas erecta, var. *Nuttalli*, Torr. and Gray. Big Bend and Yellowstone.
Geum strictum, Ait. White river to Yellowstone.
Geum album, Gmel. Fort Pierre and Mandan village.
Geum triflorum, Pursh. Fort Union.

Geum rivale, Linn. Laramie mountains.
Potentilla glandulosa, Nutt. Laramie mountains, August 24th.
Potentilla Norvegica, Linn. Council bluffs to Yellowstone.
Potentilla paradoxa, Nutt. Along banks of Missouri.
Potentilla effusa, Dougl.? Prairie near Fort Clark.
Potentilla Pennsylvanica, Linn, var. *strigosa*. Bad Lands.
Potentilla diversifolia, Lehm. Bad Lands.
Potentilla rigida, Nutt. Yellowstone.
Potentilla Canadensis, Linn. Big Sioux river.
Potentilla anserina, Linn. Niobrara river to Fort Pierre.
Potentilla fruticosa, Linn. On the Yellowstone.
Potentilla arguta, Pursh. Fort Clark and Fort Union.
Sibbaldia procumbens, Linn. Laramie mountains, August 24th.
Fragaria vesca, Linn. Along Missouri to Yellowstone.
Fragaria Virginica, Ehsh. Fort Union.
Sanguisorba annua, Nutt. Fort Union.
Rubus occidentalis, Linn. Council bluffs.
Rubus strigosus, Mich. Sparingly on Yellowstone.
Rubus villosus, Ait. Council bluffs.
Rosa blanda, Ait. On prairies generally.
Rosa lucida, Ehrh. White river; Fort Pierre.
Cratægus punctata, Jacq. White river; Big Bend, &c.
Cratægus tomentosa, var *mollis*, Gray. Mouth of Big Sioux.
Amelanchier Canadensis, Torr. and Gray. Common throughout the Upper Missouri country; bears a delicious fruit, which ripens in June.

LYTHRACEÆ.

Lythrum alatum, Pursh. Rich alluvial bottoms, Platte valley, June 3d.

ONAGRACEÆ.

Epilobium minutum, Lindl. Black hills, September 10th.
Epilobium angustifolium, Linn. Not uncommon in Kansas; also near Council bluffs.
Oenothera pinnatifida, Nutt. Bad Lands to Yellowstone.
Oenothera albicaulis, Nutt. Same localities.
Oenothera caespitosa, Nutt. Bad Lands, &c.; the common form with large flowers, and another one with flowers not more than one inch in diameter.
Oenothera montana, Nutt. Yellowstone; a small pubescent form of the latter?
Oenothera coronopifolia, Torr. and Gray. Niobrara, August 15th.
Oenothera serrulata, Nutt. Fort Pierre, and through the whole region in different varieties.

Oenothera biennis, Linn. Common along the valley of the Missouri to the mountains.

Oenothera rhombipetala, Nutt. Sand hills, August 4th.

Oenothera lavandulaefolia, Torr. and Gray. Niobrara river, August 15th.

Oenothera spinulosa, var. *Drummondii*. Loup fork of the Platte, July.

Gayophytum ramossissimum, Torr. and Gray. Black hills, September 10th.

Ludwigia palustris, Ell. Wet places in Platte valley, near mouth of Loup fork.

Gaura coccinea, Nutt. Throughout the territory; different forms, canescent. Very small-leaved, or almost glabrous, with larger leaves.

Gaura parviflora, Dougl. Bad Lands and Yellowstone country.

Gaura biennis, Linn. Along Missouri river to Council bluffs.

Circea Lutetiana, Linn. Bad Lands.

Myriophyllum spicatum, Linn. Common in ponds throughout the Upper Missouri.

Hippuris vulgaris, Linn. In standing pools, Upper Missouri.

LOASACEÆ.

Mentzelia ornata, Torr. & Gray. Common on bluffs about Fort Pierre.

Mentzelia nuda, Torr. & Gray. Bad Lands.

CACTACEÆ.

Mamillaria vivipara, Haw. From the mouth of White river to the Yellowstone. In the bottom lands it forms large cæspitose masses, but on the arid hills along the Yellowstone a simple depressed variety is noticed; both belong to the subspecies which I have named *vera*, and the latter may be distinguished as var. *simplex*.

Mamillaria Nuttalli, Engl., *forma borealis*, Cactus mamillaris, Nutt., Mam. simplex, Torr. & Gray. On White river, Fort Pierre, &c.

Opuntia Rafinesqui, var. *fusiformis*, Engl. & Big. Near Big Bend of the Missouri, below Fort Pierre.

Opuntia Missouriense, D. C. Different forms noticed in the Synopsis of the Cactaceæ of the United States. (Proceedings Am. Acad. vol. iii, 1856.) a, *rufispina*; b, *platycarpa*; c, *microsperma*; d, *subinermis*. Found all over the territory explored by the Expeditions. Durion's hills was about the most eastern locality of this species.

Opuntia fragilis, Nutt. D. C. Bad Lands to Yellowstone. This species is very nearly allied to the last, and not to the glomerate *Opuntiæ*, with which it is usually united. It is seldom found in flower or fruit, being abundantly propagated by the fragile joints which even the wind breaks and scatters. The fruit is at first fleshy, and becomes dry only at last, while the fruit of *Opuntia Missouriensis* becomes dry and papery as soon as ripe.

GROSSULACEÆ.

Ribes hirtellum, Michx. On Powder river, on rocks; a spineless, small-leaved form.

Ribes oxyacanthoides, Linn. On the Yellowstone.

Ribes floridum, L'Her. Abundant about Fort Pierre, &c., and all along the Missouri.

Ribes aureum, Pursh. With the last.

Ribes rotundifolium, Michx. Niobrara river, June 5th.

Ribes Missouriense, Nutt. Only a variety of the last.

CUCURBITACEÆ.

Echinocystis lobata, Torr. & Gray. Durion's hills, on the Missouri.

CRASSULACEÆ.

Sedum stenopetalum, Pursh. Laramie mountains.

Penthorum sedoides, Linn. In wet places. Platte valley; Loup fork.

SAXIFRAGACEÆ.

Heuchera hispida, Pursh. Fort Pierre to Yellowstone.

Heuchera Americana, Linn. Not rare in woody places along the Missouri.

Heuchera Richardsonii, R. Brown. Black hills.

HAMAMELACEÆ.

Hamamelis Virginica, Linn. Abundant in limestone woods along the Missouri to mouth of the Platte river.

UMBELLIFERÆ.

Sanicula Canadensis, Linn. Bellevue, N. T. June 20th.

Sanicula Marilandica, Linn. Council bluffs to Fort Mandan.

Sium lineare, Michx. Moist places from the mouth of the Missouri to mountains.

Sium angustifolium, Linn. Council bluffs.

Thaspium barbinode, Nutt. Rich woody places along the Missouri.

Thaspium aureum, Nutt. Near Council bluffs.

Cicuta maculata, Linn. Sargent's bluffs, Mandan village, &c.

Cymopterus glomeratus, D. C. Mouth of White river, and Bad Lands.

Cymopterus montanus, Nutt. Bad Lands.

Peucedanum fœniculaceum, Nutt. Common on high prairies around Council bluffs.

Peucedanum carnifolium, Torr. & Gray. Niobrara river.

Peucedanum nudicaule, Nutt. White river valley; in flower about the middle of April.

Osmorrhiza longistylis, D. C. Council bluffs to Niobrara.

Osmorrhiza brevistylis, D. C. Council bluffs.

Musenium divaricatum, Nutt. Fort Pierre, Bad Lands, &c.

Leptocaulis patens, Nutt. Loup Fork.

ARALIACEÆ.

Aralia nudicaulis, Linn. Bellevue, N. T.

CORNACEÆ.

Cornus florida, Linn. Along the rich wooded bottoms as far as Fort Leavenworth.

Cornus stolonifera, Michx. Wooded bottoms of Missouri from mouth to source.

Cornus sericea, Linn. Abundant along Missouri bottoms. The inner bark is much used by the Sioux Indians with their tobacco in proportion of three to one; called by them the "red osier."

CAPRIFOLIACEÆ.

Symphoricarpus occidentalis, R. Br. The most abundant shrub along the rivers and streams from the mouth of the Missouri to the mountains; often called "blue wood;" much used for making brooms; sometimes covers the river bottoms almost exclusively.

Lonicera hirsuta, Eat. Bellevue.

Triosteum perfoliatum, Linn. Not rare as high up the Missouri as mouth of Big Sioux.

Sambucus Canadensis, Linn. Common along Missouri; seen in the valley of Yellowstone.

Viburnum Lentago, Linn. Fort Union, Blackfoot country.

RUBIACEÆ.

Galium aparine, Linn. Kansas river.

Galium trifidum, Linn. Council bluffs.

Galium triflorum, Michx. Fort Pierre, Fort Union, &c.

Galium asprellum, Michx. Council bluffs.

Galium circaezans, Michx. Bellevue, N. T.

Galium boreale, Linn. Fort Clark, Fort Union.

Oldenlandia angustifolia, Gray. Along Missouri to Council bluffs.

Oldenlandia purpurea, Gray. Bellevue, N. T.

COMPOSITÆ.

Vernonia fasciculata, Michx. Quite common on prairies, valley of Missouri.

Kuhnia eupatoroides, Linn. Council bluffs to Niobrara.

Eupatorium perfoliatum, Linn. On rich bottom prairies near mouth of Big Sioux.

Eupatorium purpureum, Linn. Council bluffs to James river.

Eupatorium ageratoides, Linn. Woody bottoms Council bluffs to Fort Pierre.

Eupatorium serotinum, Michx. Bellevue, N. T.

Liatris squarrosa, Willd. A smoothish and a rough hairy form; prairies in Kansas and Nebraska, common; root tuberous.

Liatris punctata, Hook. Common on prairies along the Yellowstone; root ligneous, elongated, horizontal.

Liatris pycnostachya, Michx. Common on prairies. Bellevue, N. T.

Liatris scariosa, Willd. Western prairies, abundant.

Pectis angustifolia, Torr. North Platte.

Brickelia grandiflora, Nutt. Laramie mountains, August 24th.

Machæranthera tanacetifolia, Nees. On Powder river, Yellowstone, and Bad Lands of the Judith.

Machæranthera canescens, Gray. (*Aster canescens*, Pursh.) Along the Missouri, at the mouth of the Big Shyenne, at Fort Clark, &c.

Machæranthera viscosa (*Dicteria viscosa*, Nutt.). Common in prairie dog villages on the Yellowstone river; only the lowest leaves are sharply and divaricately toothed, all others are linear and entire; the plant is annual or biennial, six to ten inches high, divaricately branched, the heads much smaller than in the foregoing species.

Aster cordifolius, Linn. Not uncommon, Big Sioux and Niobrara.

Aster saggitifolius, Willd. Big Sioux and Niobrara.

Aster azureus, Lindl. Council bluffs.

Aster multiflorus, Ait. Council bluffs.

Aster sericeus, Vent. Fort Pierre.

Aster Novæ-Angliæ, Ait. Low places on Missouri.

Aster lævis, Linn. Upper Missouri.

Aster ptarmicoides, Nees. Black hills.

Aster angustus, Torr. & Gray. Bad Lands of Judith.

Aster pauciflorus, Nutt. Near Fort Union, September.

Aster simplex, Willd. Shyenne river, September 3d.

Aster glacialis, Nutt. Laramie mountains, August 24th.

Townsendia grandiflora, Nutt. Eagle Nest butte, White river.

Erigeron pumilum, Nutt. High hills around Fort Pierre.

Erigeron strigosum, Muhl. Low places, Vermilion prairie.

Erigeron Philadelphicum, Linn. Alluvial bottoms of Missouri.

Erigeron Canadense, Linn. Common all over Missouri country.

Erigeron compositum, Pursh. Sterile hills at Fort Union, without flower or fruit.

Erigeron glabellum, Nutt. Prairies around Fort Pierre and the Yellowstone.

Erigeron bellidiastrum, Nutt. Niobrara river, August 12th.

Erigeron macranthum, Nutt. Black hills, September 10th.

Aplopappus Nuttalli, Torr. and Gray. Bad Lands.

Aplopappus lanceolatus. Fort Union.

Aplopappus spinulosus, D. C. High prairies of the Upper Missouri.

Boltonia glastifolia, L'Her. Bellevue, N. T.

Gutiernezia Euthamiae, Torr. and Gray. Yellowstone country; also Black hills. A smoothish and a scabrous form.

Solidago rigida, Linn. Bellevue to the Yellowstone.

Solidago incana, Torr. and Gray. Fort Pierre to Yellowstone.

Solidago Missouriensis, Nutt. Bellevue to Fort Pierre.

Solidago gigantea, Ait. Common along the Missouri and Yellowstone.

Solidago speciosa, Nutt. Black hills, September 3d.

Grindelia squarrosa, Dunal. Common on high prairies from latitude 43° to the mountains; medicinal among Indians.

Chrysopsis villosa, Nutt. Common on dry hills, Fort Pierre.

Chrysopsis hispida, Hook. Bad Lands and Yellowstone.

Diaperia prolifera, Nutt. Common on Yellowstone.

Silphium laciniatum, Linn. Called by the inhabitants of the country, "Compass plant;" reaches its healthiest growth on the rich fertile bottoms of Missouri, but often found in great abundance on the high prairies. The highest point on the Missouri river that I have observed this plant, is near latitude 44°, mouth of White river; most abundant in the Platte valley, and on the broad rich bottoms between Council bluffs and Niobrara river, where it sometimes occupies large areas to the exclusion of other vegetation. That the leaves of this plant set their edges north and south, may be proved by a pocket compass. Forty-nine plants out of fifty exhibit this peculiarity. It thus becomes an excellent guide to the traveller across the pathless prairies.

Silphium integrifolium, Michx. Bellevue, N. T.

Silphium perfoliatum, Linn. Seldom seen above the mouth of Niobrara river.

Euphrosyne xanthifolia, Gray. Yellowstone and Upper Missouri in bottoms; a green and canescent form.

Iva axillaris, Pursh. Dry argillaceous hills. Fort Pierre and Fort Union.

Ambrosia trifida, Linn. Along streams and borders of woods, from mouth of Missouri to mountains. Quite abundant.

Ambrosia coronopifolia, Torr. and Gray, Fort Pierre.

Franseria Hookeriana, Nutt. Sandy bottoms of Yellowstone river.

Heliopsis laevis, Pers. Along streams in Kansas and Nebraska to Fort Pierre.

Xanthium strumarium, Linn. Sandy bottoms of Yellowstone.

Echinacea purpurea, Moench. Purple cone flower, called Rattlesnake Weed in the West, and is found abundantly throughout the country. Root very pungent. Used very effectively by the traders and Indians for the cure of the bite of the rattlesnake.

Echinacea angustifolia, D. C. Fort Pierre, Bad Lands, Yellowstone. Mostly very hispid; hoary.

Lepachys columnaris, Torr. and Gray. Common throughout the Missouri country, but most abundant from Council bluffs to Niobrara river, on the rich broad bottom prairies. In flower, July 8th. Rays usually yellow, sometimes of a deep purple velvet.

Lepachys pinnata, Torr. and Gray. Vermilion prairie. Rare.

Rudbeckia hirta, Linn. Council bluffs.

Helianthus petiolaris, Nutt. Common from Sargent's bluffs to Fort Union.

Helianthus rigidus, Defs. From Bellevue to Yellowstone.

Helianthus lenticularis, Dougl. Fort Pierre. Abundant in Indian cornfields at Fort Mandan.

Helianthus Maximiliani, Schrad. Fort Pierre to Fort Union.

Helianthus hirsutus, Raf. Big Sioux river.

Coreopsis palmata, Nutt. Bellevue, N. T.

Bidens bipinnata, Linn. Bellevue, N. T.

Bidens chrysanthemoides, Michx. Yellowstone river.

Balsamorrhiza sagittata, Nutt. Black hills.

Linosyris viscidiflora, Torr. and Gray. Fort Union.

Linosyris graveolens, Torr. & Gray. Sterile hills on the Yellowstone; very common; also Bad Lands; the larger glabrous, and the smaller a stinted canescent form.

Thelesperma filifolia, Gray. Platte valley, July 30th.

Thelesperma gracile, Gray. Sand hills, July 24th.

Dysodia chrysanthemoides, Michx. On the Yellowstone.

Gaillardia aristata, Pursh. Fort Union.

Hymenopappus tenuifolius, Pursh. Big Sioux to Fort Union and Bad Lands.

Bahia appositifolia, Nutt. Common on roadsides and in prairie dog villages, from Fort Pierre to Bad Lands and to the Yellowstone.

Actinella acaulis, Nutt. On high sterile hills, Bad Lands, and Yellowstone.

Actinella Richardsoni, Nutt. Fort Union.

Actinella lanata, Nutt. Niobrara river.

Helenium autumnale, Linn. Kansas and Southern Nebraska.

Anthemis arvensis, Linn. Naturalized to Fort Leavenworth.

Achillea millefolium, Linn. Found all over the prairie country of the West; must be indigenous west of the Mississippi.

Antennaria plantaginea, R. Br. Upper Missouri and Black hills.

Antennaria dioica, Gaertn. Fort Pierre to Yellowstone.

Antennaria margaritacea, R. Br. Laramie mountains.

Antennaria dimorpha, Nutt. Bad Lands.

Gnaphalium uliginosum, Linn. Council Bluffs.

Artemisia longifolia, Nutt. Common on high hills along the Yellowstone.

Artemisia dracunculoides, Pursh. Bellevue to Yellowstone.

Artemisia filifolia, Torr. Gravelly hills along the Platte; Bad Lands.

Artemisia Canadensis, Michx. Near Fort Laramie; also Durion's hills to Yellowstone.

Artemisia Ludoriciana, Nutt. In the Bad Lands and along the Yellowstone; always white, with deeply serrate or entire leaves.

Artemisia cana, Pursh. Abundant on the Yellowstone, and on the Missouri above Fort Union. This is the species which is properly called "sage" on the Upper Missouri; it grows shrubby, two to four feet high.

Artemisia frigida, Willd. From latitude 43° to mountains.

Artemisia tridentata, Nutt. Common in Bad Lands.

Artemisia biennis, Willd. In Platte valley.

Senecio aureus, Linn. Council bluffs and Big Sioux.

Senecio integerrimus, Nutt. About Council bluffs to mountains.

Senecio lobatus, Pers. Fort Leavenworth to Fort Pierre.

Senecio canus, Hook. Bad Lands to Yellowstone, with the upper leaves serrate or entire, tomentose, canescent or almost glabrous.

Senecio filifolius, Nutt. Black hills.

Senecio spartioides, Torr. & Gray. Niobrara river.

Senecio rapifolius, Nutt. Laramie mountains.

Senecio eremophilus, Richards. Black hills.

Cacalia atriplicifolia, Linn. Bellevue, N. T.

Cacalia tuberosa, Nutt. Not uncommon on the rich bottoms of the Missouri and Platte.

Lygodesmia juncea, Don. A very abundant plant all over the sterile hills of the Upper Missouri and its tributaries; grows most luxuriantly on the second upland prairie. It makes its first appearance near Council bluffs, and extends to the mountains.

Cirsium altissimum, Spreng. Bellevue to Fort Pierre.

Cirsium undulatum, Spreng. Arid hills and prairies from Niobrara to Fort Pierre and Bad Lands. The var. β. Torr. & Gray, with smaller heads and more deeply divided and spiny leaves, was found on the Yellowstone.

Cirsium canescens, Nutt. Bad Lands; certainly biennial with a long root; perhaps belonging to *C. undulatum*, as Torr. & Gray suggest; distinguished by the deeply pinnatifid and decurrent leaves; decurrent part $\frac{1}{2}$–$1\frac{1}{2}$ inch long, undulate and very spiny; peduncles leafy; involucre pubescent.

Nabalus asper, Torr. & Gray. Bellevue, N. T.

Nabalus racemosus, Hook. Black hills, September 3d.

Mulgedium pulchellum, Nutt. Big Sioux river.

Troximon cuspidatum, Pursh. Council bluffs and Big Sioux, Bad Lands. The white tomentose margin on the bright green leaves gives the young plant especially a very peculiar aspect.

Troximon glaucum, Nutt. Upland prairies on the Yellowstone, with long and short leaves, villous or glabrous scales of involucre.

Crepis runcinata, Torr. & Gray. Yellowstone.

Lactuca Ludoviciana, D. C. Fort Mandan (Nuttall's original locality), Bad Lands, down to the mouth of the Big Sioux river. A very distinct and well-marked species and a true *Lactuca*. Apparently biennial or perennial; 1–3 feet high; cauline leaves oval, runcinate or almost entire, clasping with an auriculate base; heads paniculate, much larger than in any other North American species, about 9 lines long.

Sonchus asper, Vill. Fort Leavenworth, K. T.

Stephanomeria runcinata. Bad Lands of Judith.

Villanova chrysanthemoides, Gray. *Plantæ Wrightiana*, Plate 2. Laramie mountains, August 24th.

Hieracium scabrum, Michx. Laramie mountains.

Hieracium Canadense, Michx. Laramie mountains.

LOBELIACEÆ.

Lobelia cardinalis, Linn. Moist places along the Missouri to the Big Sioux; in Kansas, on Big Cottonwood creek.

Lobelia spicata, Lam. Mouth of the Platte.

Lobelia inflata, Linn. Yellowstone valley, where it is cultivated by the Crow Indians, and used in their religious ceremonies.

CAMPANULACEÆ.

Campanula rotundifolia, Linn. Prairies near Fort Clark; abundant, but very rare elsewhere.

Campanula aparinoides, Pursh.

Specularia perfoliata, A. D. C. Bad Lands, &c.

Specularia paradoxa, Nutt. (*Sub prismato carpo.*) Bad Lands.

ERICACEÆ.

Vaccinium Myrtillus, Hook. Black hills.

Arctostaphylos Uva-ursi, Spreng. Very abundant on the high rocky hills about Fort Clark; also abundant in the mountains. It is the real "Kininkkinnick" of the

Indians, and used by them to mix with their tobacco, in preference to any other plant. The bark of *Cornus sericea* is used as a substitute only in the absence of the *A. uva-ursi.*

Chimaphila umbellata, Nutt. Black hills.

Pyrola minor, Linn. Laramie mountains, August 20th.

Pterospora Andromedea, Nutt. Laramie mountains.

EBENACEÆ.

Diospyros Virginiana, Linn. Occurs in Kansas.

PLANTAGINACEÆ.

Plantago major, Linn. Along Missouri and Yellowstone rivers.

Plantago eriopoda, Torr. Saline marshes near Fort Union.

Plantago Virginica, Linn. Fort Pierre.

Plantago Patagonica, var. *gnaphalioides.* Very abundant in sandy soil and gravelly places on the Upper Missouri.

Plantago pusilla, Nutt. On prairies near Fort Pierre; also on the river opposite St. Joseph, in Kansas.

PRIMULACEÆ.

Androsace occidentalis, Pursh. Bad Lands, Fort Pierre.

Lysimachia stricta, Ait. Platte valley, and along Missouri.

Lysimachia ciliata, Linn. Common from Council bluffs to Bad Lands.

Glaux maritima, Linn. Bad Lands of the Judith, Blackfoot country.

BIGNONIACEÆ.

Martynia proboscidea, Glox. Fort Pierre.

LENTIBULACEÆ.

Utricularia inflata, Walt. In ponds, Council bluffs, White river valley.

OROBANCHACEÆ.

Phelipæa Ludoviciana, Don. Sandy prairies, Yellowstone.

Aphyllon fasciculatum, Torr. & Gray. Great Bend of Missouri.

Aphyllon uniflorum, Torr. & Gray. Council bluffs.

SCROPHULARIACEÆ.

Scrophularia nodosa, Linn. Common in prairies throughout the Upper Missouri country.

Scrophularia nodosa, var. *discolor.* Smaller, with firmer leaves, lower side of leaves pubescent and very pale; Fort Pierre.

Chelone glabra, Linn. Along valley of Missouri to latitude 43°.

Pentstemon grandiflorus, Fraser. A beautiful plant found along the bluffs of the Platte, banks and sandy bottoms of Missouri to mountains.

Pentstemon cœruleum, Nutt. Eagle Nest hill, White river valley.

Pentstemon erianthum, Nutt. Hills around Fort Pierre.
Pentstemon albidum, Nutt. Low with glabrous calyx. Hills around Fort Pierre.
Pentstemon cristatum, Nutt. On high prairies; Upper Missouri.
Pentstemon gracile, Nutt. Prairie bottoms, near Fort Pierre.
Pentstemon pubescens, Solander. Fort Pierre; June.
Pentstemon levigatus, Solander. Fort Leavenworth; May.
Pentstemon acuminatus, Lindl. Sandhills on Loup fork.
Pentstemon Fendleri, Gray. Sandhills on Loup fork.
Pentstemon confertus, Lindl. Laramie mountains, August 24th.
Pentstemon ———? undetermined. Niobrara.
Mimulus ringens, Linn. Council bluffs and Big Sioux.
Mimulus Jamesii, Torr. On the Platte. Dr. Cooper.
Gratiola Virginica, Linn. Quite common along the Missouri.
Veronica anagallis, Linn. Common; Council bluffs.
Veronica scutellata, Linn. With the preceding.
Veronica peregrina, Linn. Fort Pierre.
Veronica Americana, Schwein. Niobrara river.
Veronica arvensis, Linn. Council bluffs to Bad Lands.
Ilysanthes gratioloides, Benth. Yellowstone country.
Limosella aquatica, Linn. Wet places on the banks of the Yellowstone. This is the same as the European plant.
Synthyris Houghtoniana, Benth. Black hills.
Gerardia purpurea, Linn. Council bluffs.
Gerardia tenuifolia, Vahl. Fort Pierre.
Castilleia sessiliflora, Pursh. Fort Pierre, Bad Lands, Yellowstone, &c.
Castilleia septentrionalis, Lindl. Black hills.
Castilleia linariafolia, Benth. Laramie mountains, August 24th.
Castilleia argutifolia, Nutt. Laramie mountains.
Melampyrum Americanum, Michx. Extends up the Missouri as far as the mouth of the Platte.
Pedicularis lanceolata, Michx. Fort Pierre, Yellowstone, &c.
Orthocarpus luteus. Near Powder river on Yellowstone.

ACANTHACEÆ.

Dipteracanthus strepens, Nees. Fort Leavenworth to mouth of Niobrara river.
Dianthera Americana, Linn. Platte valley.

VERBENACEÆ.

Verbena urticifolia, Linn. Dixon's bluffs, on Missouri.

Verbena bipinnatifida, Nutt. Bad Lands and Yellowstone river. Some forms of *Verbena* were found near the mouth of Kansas river, and at Sargent's bluffs, which are evidently hybrids, probably between *V. urticifolia* and *V. bracteosa*. Numerous hybrids between the species of *Verbena* are not rare in the vicinity of St. Louis, which I have noticed in Silliman's Journal, Jan. 1844, page 99.

Verbena bracteosa, Michx. A very common plant about prairie dog villages on the Upper Missouri.

Verbena hastata, Linn. Platte valley.

Verbena stricta, Vent. Platte valley; July.

Verbena Aubletia, Linn. Along the Missouri in Kansas.

Lippia lanceolata, Michx. Fort Leavenworth, Kansas Territory.

Phryma Leptostachya, Linn. Not rare along the Missouri to latitude 43°.

LABIATÆ.

Teucrium Canadense, Linn. Bad Lands, &c.

Mentha Canadensis, Linn. All along the Missouri to the Yellowstone.

Mentha borealis, var. *glabrata*. Loup fork, July 6th.

Lycopus sinuatus, Ell., Benth. Council bluffs to above Fort Pierre. Some forms are very deeply pinnatifid.

Lycopus obtusifolius, Michx., Benth. Common along the Yellowstone. Abundantly distinguished from the former by the larger flowers with included stamens. Sterile filaments reduced to mere warts and naked throat of corolla. The leaves are somewhat clasping with a sessile base, the lowest ones obtuse, but the upper ones acute and even acuminate, regularly serrate and on both sides abundantly glandulo-punctate.

Isanthus cœruleus, Michx. Fort Riley. Found by Dr. Cooper.

Pycnanthemum lanceolatum, Pursh. Loup fork, July 31st, 1857.

Hedeoma pulegioides, Pers. Bad Lands.

Hedeoma hispida, Pursh. Council bluffs to Bad Lands and Yellowstone. Leaves strongly ribbed on the lower side, scarcely punctate, longer than the verticils; teeth of punctiferous calyx spreading.

Hedeoma Drummondi, Benth. Sandy soil on the Yellowstone river, common. Similar to the preceding but perennial with a long tap root; leaves nerveless, strongly punctate on both sides, shorter than the verticils; teeth of fructiferous calyx connivent.

Salvia trichostemoides, Pursh. Fort Pierre, Bad Lands.

Salvia Pitcheri, Torr. Collected by Dr. Cooper near Fort Riley.

Monarda Bradburiana, Beck. Fort Pierre.

Monarda fistulosa, Linn. The form usually named *M. allophylla*, Fort Pierre and Bad Lands to Yellowstone.

Monarda aristata, Nutt. Sandhills on Loup fork, August 1st.

Blephilia ciliata, Raf. Bad Lands.

Lophanthus nepetoides, Benth. Council bluffs.

Lophanthus scrophulariaefolius, Benth. Bad Lands.

Lophanthus anisatus, Benth. Yellowstone.

Physostegia Virginiana, Benth. Fort Pierre.

Scutellaria parvula, Michx. Fort Pierre.

Scutellaria galericulata, Linn. Fort Berthold to Fort Union, a smooth and a pubescent form.

Brunella vulgaris, Linn. Loup fork, July 30th.

Brunella officinalis, Linn. Loup fork, July 30th.

Marrubium vulgare, Linn. Council bluffs, &c.

Stachys palustris, Linn. Bad Lands, Yellowstone.

BORAGINACEÆ.

Onosmodium Virginianum, D. C. Prairies from Bellevue to Fort Pierre.

Onosmodium hispidum, Michx. Prairies around Teton river, near Fort Pierre.

Onosmodium molle, Michx. Loup fork, July 24th.

Lithospermum breviflorum, Engl. & Gray. (Plant. Linheim.) Fort Pierre, Bad Lands, Yellowstone. Flowers smaller than in the original Texan specimens, only about one line long; style shorter than corolla; no trace of scales, nuts large, shining, impressed, punctate only on the ventral side. Some forms are decumbent, others erect; these latter resemble in fruit very closely *Lithospermum longiflorum*, which may be distinguished by the more canescent pubescence. The somewhat larger calyx, the rather less turgid nuts, and especially where it has not fallen off, the very long style. Is this plant really distinguishable from *L. angustifolium?*

Lithospermum breviflorum, var. *punctulosum*, Engelmann. Hispidum, caulibus e radice perpendiculari pluribus, erectis foliis lincaribus; floribus pseudo-axillaribus minutis; nucibus minoribus undique exsculpto punctulosis. Sandy bottoms about Fort Union at the mouth of the Yellowstone river. The flowers are absolutely identical with those of the last, otherwise the much greater roughness and the curiously punctate nuts would seem to indicate specific difference.

Lithospermum hirtum, Lehm. Council bluffs.

Lithospermum canescens, Lehm. Same place.

Lithospermum longiflorum, Spreng. Council bluffs to Bad Lands.

Lithospermum Mandanense, Nutt. Mouth of Big Sioux river, in May.

Lithospermum angustifolium, Michx. Near mouth of Powder river on Yellowstone.
Mertensia lanceolata, D. C. White river and Bad Lands to Fort Pierre.
Myosotis verna, Nutt. Bad Lands and Fort Pierre.
Echinospermum Lappula, Lehm. Fort Pierre.
Echinospermum patulum, Lehm. From Niobrara and White river to Bad Lands, Fort Pierre, and Yellowstone. More abundant than the last.
Echinospermum strictum, Nees. Fort Pierre.
Eritrichium glomeratum, D. C. Fort Pierre, Bad Lands to the Yellowstone. The young specimens from White river are white canescent, the old ones from Fort Union are very rough and green; the seeds are more or less tubercled, style persistent, much thickened below.
Eritrichium floro-cinereum, Torr. (ined. Fendler plants.) On Platte river near Fort Laramie.
Eritrichium micranthum, Torr. (Fendler, 635.) Niobrara river, August 16th.
Eritrichium suffruticosum, Torr. Fort Laramie, August 13th.
Cynoglossum Morrisoni, D. C. Fort Pierre and White river.

HYDROPHYLLACEÆ.

Hydrophyllum Virginicum, Linn. Council bluffs and higher up on the Shady river banks.
Hydrophyllum appendiculatum, Michx. Fort Pierre.
Hydrophyllum macrophyllum, Nutt. Shady woods as high up the Missouri as mouth of White river, and in White river valley. Most abundant in the carboniferous limestone regions of Council bluffs, April.
Ellisia ambigua, Nutt. Prairies and woods from Fort Leavenworth to the Yellowstone. The larger specimens, have the flowers frequently in naked racemes.
Ellisia Nyctelea, Linn. About old houses and gardens to Big Sioux, and along old roads in prairie dog villages on the Upper Missouri.
Phacelia circinata, Jacq. In Kansas; Dr. Cooper.

POLEMONIACEÆ.

Phlox reptans, Linn. Above Council bluffs.
Phlox pilosa, Linn. Above Council bluffs.
Phlox Hoodii, Hook. Fort Union to Bad Lands.
Phlox divaricata, Linn. Council bluffs and Platte valley.
Collomia linearis, Nutt. Common about Fort Pierre; Fort Union.
Gilia longiflora, Torr. In sandhills of Niobrara river.
Gilia congesta, Hook. White river to Yellowstone.

CONVOLVULACEÆ.

Calystegia sepium, R. Br. Council bluffs to Yellowstone, Loup fork.

Calystegia spithamaea, Pursh. Council bluffs to Fort Pierre.

Convolvulus argentea, Pursh. Bad Lands, Fort Union, and Yellowstone.

Ipomea leptophylla, Torr. I have seen this plant in but one locality along the Missouri; Bear creek near "Bad Lands." But in the sandhills on Loup fork, along the Niobrara, and around Fort Laramie, it is very abundant.

Cuscuta glomerata, Choisy. Abundant on sandy bottoms of Missouri.

Cuscuta Gronovii, Willd. Woodlands on Missouri.

Cuscuta decora, Choisy. Bottoms of Missouri.

SOLANACEÆ.

Solanum heterandrum, Pursh. Fort Pierre to Yellowstone.

Solanum nigrum, Michx. Not rare on the sandy bottoms of Missouri.

Solanum triflorum, Nutt. Very abundant in prairie dog villages on Upper Missouri.

Solanum Carolinense, Linn. Along Missouri to Council bluffs.

Physalis lanceolata, Michx. Sandy bottoms of Missouri to Fort Pierre.

Physalis viscosa, Linn. Sandy bottoms of Missouri to mountains.

Androcera lobata, Nutt. Very abundant about old trading houses, along old roads, and in prairie dog villages on Upper Missouri.

Datura stramonium, Linn. Introduced as high up the Missouri as Council bluffs.

GENTIANACEÆ.

Gentiana alba, Muhl. Fort Union.

Gentiana affinis, Griesb. Black hills, Sept. 21st.

Eustoma Russelianum, G. Don. Around saline lakes in the sandhills of Loup fork and Niobrara. Very abundant. August.

APOCYNACEÆ.

Apocynum cannabinum, Linn. Abundant on low bottoms of Missouri to mountains.

Apocynum androsæmifolium, Linn. Black hills, September 4th.

ASCLEPIADACEÆ.

Asclepias macranthera, Torr. Not rare on the moist prairies of the Upper Missouri, Loup fork, and Platte valley; July 16th.

Asclepias incarnata, Linn. Moist places on the Loup fork and Platte.

Asclepias speciosa, Torr. Fort Pierre, &c.

Asclepias purpurascens, Linn. Council bluffs.

Asclepias pubescens. Forts Pierre and Clark.

Asclepias Meadi, Torr. Loup fork, sandhills.

Asclepias tuberosa, Linn. Mouth of Big Sioux, and in Platte valley.

Asclepias verticillata, Linn. Abundant on prairies, Fort Pierre.

Anantherix viridis, Nutt. Platte valley, Loup fork, July 16th.

Acerates longifolia, Nutt. Common around Fort Pierre.

Acerates angustifolia, Nutt. With preceding.

Acerates viridiflora, Ell. Dwarfed. Loup fork, July 27th.

OLEACEÆ.

Fraxinus Americana, Linn. Generally diffused throughout the Northwest.

ARISTOLOCHIACEÆ.

Asarum Canadense, Linn. Near Council bluffs.

NYCTAGINACEÆ.

Oxybaphus nyctagineus, Sweet. Fort Pierre, &c.

Oxybaphus floribundus, Choisy. Fort Clark.

Oxybaphus hirsutus, Sweet. Yellowstone.

Oxybaphus angustifolius, Sweet, and var. *decumbens*. Fort Pierre to Yellowstone.

Abronia fragrans, Nutt. Yellowstone.

Abronia cycloptera, Gray. Yellowstone.

CHENOPODIACEÆ.

Chenopodium album, Linn. Common all along the Missouri.

Chenopodium glaucum, Linn. Along the Yellowstone.

Chenopodium ambrosioides, Linn. Mouth of Milk river.

Chenopodium urbicum, Linn. Big Muddy, Fort Union.

Atriplex hastata, Linn. Little Rocky Mountain creek.

Cycloloma platyphyllum, Moquin. Laramie mountains, August 24th.

Monolepis Nuttalliana, Moquin. Fort Union.

Monolepis chenopodioides, Moquin. Below Fort Pierre, along Missouri and Yellowstone to Fort Sarpy.

Obione speciosa, Moquin. Bad Lands to Yellowstone.

Obione canescens, Moquin. Throughout the Missouri and Yellowstone region.

Obione argentea, Moquin. Abundant on arid hills near mouth of Yellowstone.

Obione Suckleyana, Torr (in Stevens's Report, P. R. Surveys, in ed. fig. 3), Fort Union

Eurotia lanata, Moq. Bad Lands to Yellowstone, Fort Laramie.

Kochia dioica, Nutt. Fort Pierre to Yellowstone.

Corispermum hyssopifolium, Linn. Yellowstone; hairy variety on sandbars along Missouri, Fort Union, August 15th.

Suæda furticosa, Forsh. Saline places on Yellowstone.

Suæda maritima, Dumort. Milk river.

Chenopodina depressa, Moq. Saline places, Yellowstone.

Salicornia herbacea, Linn. Saline places, Fort Union.

Sarcobatus vermicularis, Nees. This is one of the most abundant shrubs on the Upper Missouri. It makes its first appearance near latitude 44°, and seems to thrive best in the saline clays of the Cretaceous and Tertiary formations. It is sometimes called "grease-wood" by the traders, and is often used for fuel by them on the Yellowstone river, where it grows to the height of ten or twelve feet, with trunks two to three inches in diameter. On the Yellowstone and along the Missouri, it sometimes covers many square miles to the exclusion of other plants.

Schoberia calceoliformis, Moq. Yellowstone.

AMARANTHACEÆ.

Montelia tamariscina, Gray. Sandhills on Loup fork.

Amaranthus albus, Linn. Sandy bottoms and shores of Missouri.

Amaranthus retroflexus? Linn. Bad lands.

Amaranthus hybridus. Fort Union.

Amaranthus blitum. Fort Union.

Frœlichia Floridana, Moq. Sandhills.

POLYGONACEÆ.

Rumex altissimus, Wood. All along the Missouri to Bad Lands.

Rumex maritimus, Linn. Along Missouri and Yellowstone.

Rumex persicarioides, Linn. Sandy bottoms of Missouri.

Rumex venosus, Pursh. Old Ponca village, Loup fork.

Polygonum amphibium, Linn. Low wet places along the Missouri.

Polygonum aviculare, Linn. Council bluffs, along the Missouri.

Polygonum tenue, Michx. Council bluffs to mountains.

Polygonum orientale, Linn. Council bluffs.

Polygonum Pennsylvanicum, Linn. Bad Lands.

Polygonum persicaria, Linn. Fort Sarpy on the Yellowstone.

Polygonum ramosissimum, Michx. Bad Lands.

Polygonum dumetorum, Linn. Council bluffs.

Polygonum convolvulus, Linn. Black hills.

Polygonum nodosum. Chardon's creek in Blackfoot country.

Eriogonum annuum, Nutt. Yellowstone and Bad Lands.

Eriogonum flavum, Nutt. Bad Lands to Yellowstone.

Eriogonum gnaphaloides, Benth. On arid hills, Fort Union, and Bad Lands.

Eriogonum alatum, Torr. Fort Laramie.

Eriogonum aureum. Shyenne river.

Eriogonum umbellatum, Torr. Laramie mountains.

Eriogonum effusum, Nutt. Platte valley.

Eriogonum Jamesii, Benth. Sandhills.

Eriogonum rotundifolium, Benth. Bad Lands of the Judith.

Eriogonum brevicaule, var. *lyptophyllum*, Torr. Laramie mountains.

Oxyria digyna, Campd. Black hills.

LAURACEÆ.

Benzoin odoriferum, Nees. Woody bottoms along Missouri, below Niobrara.

ELAEAGNACEÆ.

Shepherdia argentea, Nutt. Very abundant from mouth of Big Sioux river to the mountains. It bears a profusion of red, acid fruit, called buffalo berries.

Eleagnus argentea, Pursh. I have seen this shrub in but one locality in Missouri, near Fort Clark, on the high Tertiary hills.

SANTALACEÆ.

Comandra umbellata, Nutt. Fort Pierre and on the Yellowstone.

EUPHORBIACEÆ.

Euphorbia corollata, Linn. Quite common on Missouri to latitude 45°.

Euphorbia marginata, Pursh. Very abundant to mountains.

Euphorbia maculata, Linn. Same as last.

Euphorbia polygonifolia, Linn. Along old roads, Upper Missouri.

Euphorbia dictyosperma, Fisch & Moq. Fort Pierre.

Euphorbia glyptosperma, Engel. Common all over Western plains.

Euphorbia inæquilatera, Souder in Linnea. With the last.

Euphorbia Geyeri, Engel. Near mouth of Powder river, on Yellowstone.

Euphorbia hypericifolia, Linn. Sandhills on Loup fork, also along Missouri.

Euphorbia hexagona, Nutt. Sandhills of Loup fork, Niobrara. Abundant.

Croton muricatum, Nutt. Sandhills.

URTICACEÆ.

Ulmus fulva, Michx. Abundant on the rich bottoms of Missouri to Big Sioux, and ceases to appear at the mouth of Niobrara river.

Ulmus Americana, Linn. Along rivers and streams to mountains.

Celtis occidentalis, Linn. Abundant near to Niobrara river.

Morus rubra, Linn. Very abundant to mouth of Big Sioux; seen sparingly, and of small growth to the mountains.

Urtica gracilis, Ait. Thickets and streams to Niobrara.

Urtica Canadensis, Linn. Same as preceding.

Parietaria Pennsylvanica, Muhl. Missouri and Yellowstone.

Humulus Lupulus, Linn. Most abundant in the Upper Missouri country.

PLATANACEÆ.

Platanus occidentalis, Linn. Abundant on the rich bottoms of Missouri and Kansas; but ceases to appear about one hundred miles above Council bluffs.

JUGLANDACEÆ.

Juglans cinera, Linn. Big Sioux.

Juglans nigra, Linn. Does not extend above latitude 43°.

CUPULIFERÆ.

Quercus tinctoria, Bartram. Council bluffs and Big Sioux.

Quercus rubra, Linn. With preceding.

Quercus macrocarpa, Michx. Extends to mountains.

Quercus obtusiloba, Michx. Bad lands.

Corylus Americana, Walt. Abundant around Council bluffs.

BETULACEÆ.

Betula glandulosa, Michx. Laramie mountains, August 26th.

Alnus ——— *?* Black hills.

SALICACEÆ.

Salix longifolia, Muhl. In different forms along Missouri and Yellowstone.

Salix nigra, Marshall. Council bluffs.

Salix ——— *?* Fort Pierre.

Salix ——— *?* Forks of White river.

Salix ——— *?* Fort Pierre, June 18th.

Salix ——— *?* Medicine creek.

Populus tremuloides, Michx. Black hills.

Populus monilifera, Ait. A large tree, constituting by far the greater portion of the timber along the valley of the Missouri.

Populus ———. Called in the West "bitter Cottonwood." Makes its first appearance near Fort Laramie. Have never observed it along the Missouri. A few small trees observed near the head of the Shyenne, at the base of Bear Peak.

CONIFERÆ.

Pinus Engelmanni, Torr. On the Yellowstone.

Pinus ponderosa, Douglass. Black hills.

Abies Douglassi. Bad lands of the Judith.

Juniperus Virginiana, Linn. Along Missouri to mountains.

Juniperus communis, Linn. Fort Union.

LIST OF NEBRASKA CARICES.

BY PROF. CHESTER DEWEY.

C. vulpina, Linn. A well-known European species, first found in Ohio in our country some years since, abounds in Nebraska of large size: cannot be confounded with C. stipata, above Fort Pierre.

C. vulpinoidea, Michx.

C. multiflora, Michx. Fort Pierre.

C. stipata, Muhl. Little Sioux River.

C. rosea, Schk. Southern Nebraska.

var. *radiata*, Dew. Southern Nebraska.

C. setacea, Dew. Southern Nebraska.

C. teretiuscula, Good. Southern Nebraska.

C. Muhlenbergi, Schk. Missouri, below Fort Pierre.

C. cephaloidea, Dew. Near Fort Leavenworth.

C. Hookeriana, Dew. Missouri, below Fort Pierre.

C. stenophylla, Wahl. Upper Missouri. Well known in the Tyrol; found also in the Rocky Mountains, and in Nebraska, Dr. Hayden. First published as American also by Dr. Boott.

C. Douglasi, Boott. West of Fort Pierre. From N. W. Coast and Rocky Mountains, first described by Dr. Boott; since found so far south, like *C. Richardsoni* in its wide diffusion.

C. Nuttalli, Dew. Yellowstone river. This species, found by Mr. Nuttall in his botanic explorations on the Rocky Mountains, had escaped my memory, and I gave to the specimens from Nebraska the name of my young friend, Mr. Meek, in Silliman's Journal. Its spikes are closely aggregated into a head; its fruit small, ovate and short-lanceolate, and much shorter and narrower than the broad long-lanceolate scale; culm 3 to 4 inches high, with almost setaceous leaves. These characters separate it from the next preceding species.

C. marcida, Boott. Abundant over Southern Nebraska.

C. cristata, Schw. Little Sioux river.

C. straminea, Willd. Above Fort Pierre.

var. *minor*, Dew. Above Fort Pierre.

C. scirpoides, Schk. Near Fort Leavenworth.

C. mirabilis, Dew. Common.

C. fistucacea, Schk. Missouri, below Fort Pierre.

C. scoparia, Schk. Common over East Nebraska.

C. tenera, Dew. Missouri, below Fort Pierre.

C. leporina, Linn. Credited before to the Arctic Regions, and not very common.

C. petasata, Dew. Upper Missouri, collected first in Arctic America, and is abundant in Nebraska.

C. festiva? Dew. (Too old to decide.) Near Fort Leavenworth.

C. curta, Good. Yellowstone river.

C. obtusata, Lily. Long known in Europe, and found on the Rocky Mountains and in Nebraska.

C. grisea, Walk.

C. laxiflora, Schk. Fort Leavenworth.

C. arctata, Boott. Missouri, near Fort Pierre.

C. Meadi, Dew. In Michigan, and now in Nebraska.

C. eburnea, Boott. Missouri river.

C. Crawei, Dew. Missouri river.

C. Steudeli, Kunth. Missouri river. First found in Ohio.

C. Davisi, Torrey. Yellowstone river.

C. Shortiana, Dew. Kentucky, and in Nebraska.

C. marginata, Muh. Missouri, near Fort Pierre, as figured by Schk.

C. hystricina, Willd. Eagle-nest creek.

C. laxiflora, Lam., not of Schk. *C. anceps*, Schk., and of American authors for years. Near Fort Clark.

C. blanda, Dew. *C. conoidea*, Muh. Near Fort Clark.

C. aristata R., Br. Abundant at the "Bad Lands."

var., *longo-lanceolata*, Dew. The scale as long as and often longer than the fruit, narrow. "Bad Lands."

C. lanuginosa, Michx. On the Yellowstone.

C. riparia, Good. Along the Missouri.

C. vesicaria, Linn. Along the Missouri.

C. lacustris, Willd. Common on the Weters.

C. longirostris, Tor. Along the Missouri.

C. piliformis, Good. Eagle-nest creek.

C. ampullacea, Good. Along the Missouri.

C. monile, Tuckerman. Along the Missouri.

C. utriculata, Boott. Abundant along streams.

C. trichocarpa, Muh. Along the Missouri.

C. lævi-conica, Dew. Along Big Sioux. Staminate spikes 2 or 3, cylindric and slender; pistillate spikes 2, sometimes 3, cylindric, erect, oblong, subdensi-flowered, leafy-bracteate, the lowest short pedunculate and vaginate; stigmas three; fruit long-conic, slender and tapering, scarcely inflated at base, bifurcate, and oblique at the orifice, smooth and obsoletely striate, as long or a little longer than the ovate and lanceolate scale; culm tall and slender. (American Journal of Science, Vol. XXIV, p. 47, Second Series.) The smooth and slender conic fruit and scale remove this plant from *C. trichocarpa*.

C. acuta, Linn. Eagle-nest creek.

C. vulgaris? Fries. Eagle-nest creek.

C. stricta, Lam. Eagle-nest creek.

C. strior, Dew. Eagle-nest creek.

C. recta, Boott. Near Fort Pierre. Discovered by the English Exploring Expedition in Arctic America, and described by Dr. Boott.

C. Nebraskensis, Dew. Near Fort Pierre. Staminate spikes two, oblong and near, the lower small and sessile; pistillate spikes two to four, oblong, short-cylindric, densely flowered, the upper often staminate at their apex and sessile, the lower short-pedunculate, all with leafy bracts; fruit with two stigmas, convex, obovate or elliptic, short-pointed above, and tapering at the base, a little shorter than ovate and acute, or lanceolate scale; stem about a foot and a half high, sharp-triquetrous edges, and smooth, leafy towards the base. (American Journal, Vol. XVIII, p. 102, Second Series.)

C. Haydenii, Dew. Near Fort Pierre, and at Eagle-nest creek. Staminate spike single, sometimes two, cylindric, the lower sessile, and sometimes with flowers at the base; pistillate spikes three to five, long-cylindric, erect, graceful or slender, 2 to 3 inches long; base flowered, especially at the lower part of the spikes, one or more staminate at the apex, sessile except the lowest; fruit, *distigmatic*, elliptic, convex, short-beaked, and entire at the orifice, about half the length of the scale, which is lanceolate, black, white line on the back, culm 2 to 3 feet high, rather slender, leafy at the base.*

* When Sprengel printed his Systema Vegetabilium, Vol. III, in 1826, it contained 267 species of Carex, all the Reed-grasses or sedges then known to him,—a very host of species of one genus. Since that time the number has increased to 800 or more. Perhaps 350 of these have been found in North America, and about 250, to speak in general terms, have been found in the United States, east of the Mississippi. The above Catalogue contains more than 50 species, collected in Nebraska Territory, most of which are spread over a wide extent of our country, so prolific in vegetable life.

C. D.

NOTE.

The foregoing Report was written, for the most part, over three years since; and contains a condensed statement of the geological information concerning the Upper Missouri which had been secured up to that time. It may be regarded as a report of progress, and will be followed by the more complete and more matured results of the Expedition of 1859 and '60, under Capt. Wm. F. Raynolds, which are now in an advanced stage of preparation. The cost of publication has rendered it necessary to omit the illustrative sections, and many other details, which would have added materially to the value of the work.

A detailed account of the geology of the White River group, Loup River beds, and the Judith River deposits, has been omitted, on account of the intention of the author to visit those localities again at no distant day, and to make a thorough exploration of them.

The Map accompanying the memoir is reduced from the military map of Nebraska and Dakota, by Lieut. G. K. Warren, T. E. Many of the details of the topography have been omitted.

It remains now for the author to acknowledge his indebtedness to several gentlemen who have aided him during the progress of the Report. To Lieut. G. K. Warren, under whose direction, as commander of the Expeditions, the greater portion of the information was obtained, the writer is indebted for every facility and assistance that could be afforded, consistent with the public service. The memoir itself bears ample evidence of the kind aid and counsel, ever freely given, by my friend and associate, Mr. F. B. Meek. Messrs. Baird, Cope, Gill, Lea, and Binney revised the Catalogues in their respective departments. Dr. Engelmann and Prof. Dewey prepared the Catalogue of Plants. Dr. J. S. Newberry furnished some valuable information for the Map in regard to Southern Kansas.

To the Smithsonian Institution, and to its distinguished Secretary, Prof. Henry, the writer, during all his investigations in regard to the geology and natural history of the Upper Missouri, is indebted for the use of rooms, books, and every facility essential to the successful prosecution of his labors.

ERRATA.

Page 14, last line of second paragraph, for "*Meycochœrus*" read, "*Merychochœrus*."

Page 16, fourth line from bottom, for "La Pule" read "La Prele."

Page 18, fifth line from top, for "above" read "preceding."

Page 36, sixth line from top, for "Juya-kara Peak" read "Inya-kara Peak."

Page 68, second line from bottom, for "will" read "shall."

Page 69, for "*Ammonites alpinianus*" read "*Ammonites Galpinianus*."

Page 94, for "*Corbula matriformis*" read "*Corbula mactriformis*."

Page 116, first line of second paragraph, for "appears" read "appear."

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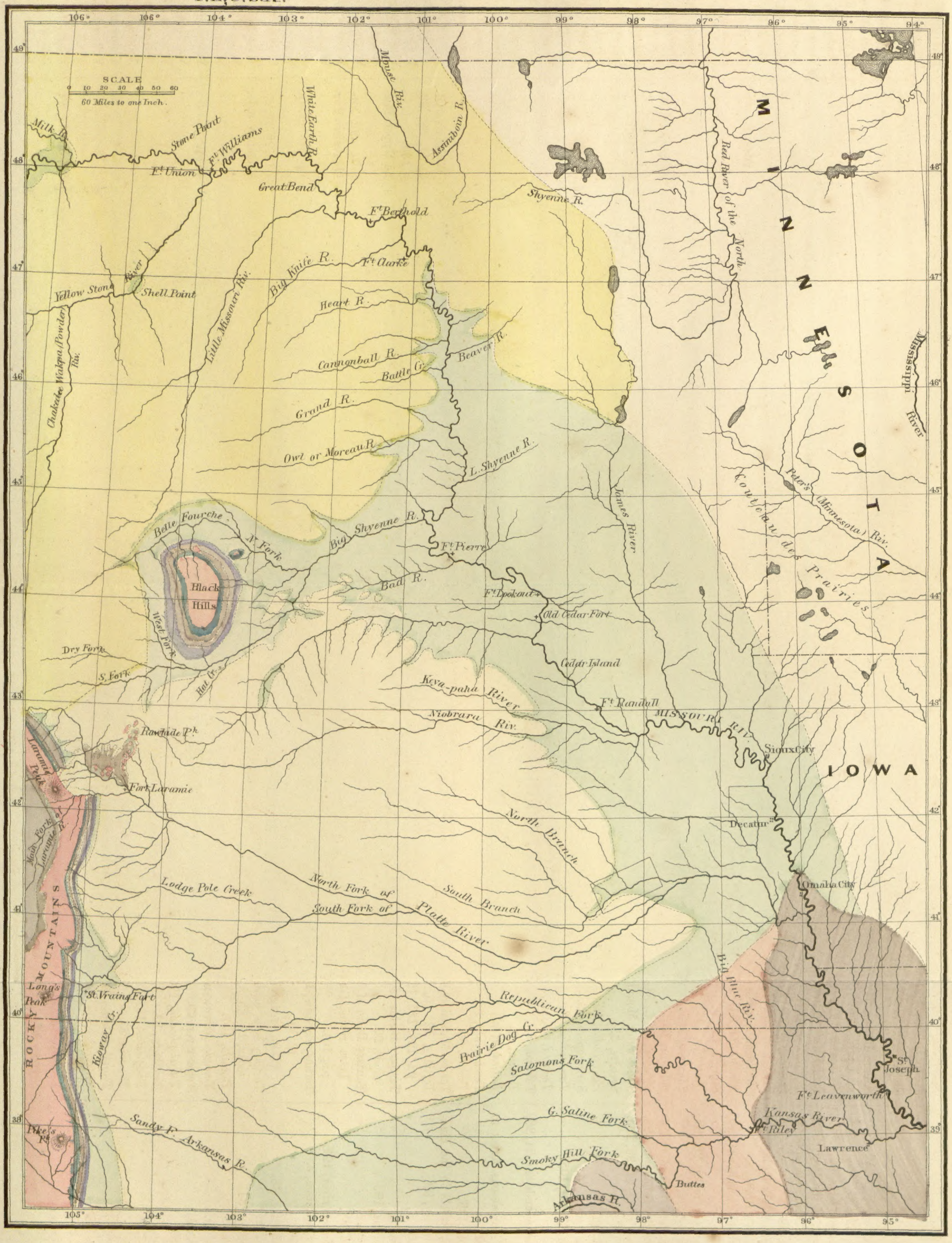
OUTLINE REDUCTION OF THE

MAP OF KANSAS, NEBRASKA AND DACOTA.

TOPOGRAPHY BY LIEUT. G.K.WARREN, T.E, U.S.A.

GEOLOGY BY Dr. F.V.HAYDEN.